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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES —
Twenty-fifth Annual Meeting, New England Association 109
Second Annual Meeting, Michigan Gas Association 109
February Meeting, Guild of Gas Managers 109
EDITORIALS —
Briefly Told 109
Obituary Note, Mr. Sylvester S. Townsend—Obituary Note, Mr. Peter Coffey—Notes.
The London "Lancet's" Report on Incandescent Gas Lighting..... 110
*Rusby's Water Gas Apparatus..... 112
What is a Heat Unit..... 114
About Chimneys, by Mr. F. T. Hodgson..... 115
Special English Correspondence..... 118
The Distribution of Electricity—The Gas Industry in 1894—A Proposed Experimental Gas Works.
The Determination of Tar in Gas..... 119
An Out-of-the-Way Coal Field..... 119
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 120
The Waterbury (Conn.) Company to Increase Its Stock—An Electric Franchise for Dallas, Texas—Annual Meeting, Cleveland, O.—Annual Meeting, Little Rock, Ark.—To Manufacture a Gas Engine—The Cartersville (Ga.) Company Reorganized—Annual Meeting, Columbus, Pa.—Contract for the Berlin Iron Bridge Company—The Brookline (Mass.) Company May Increase Its Stock—Annual Meeting, Brooklyn, N. Y.—A Speedily Finished Contract—An Illinois Bill—Annual Meeting, San Francisco, Cal.—And Other Items.
The Market for Gas Securities..... 122

[OFFICIAL NOTICE.]

Twenty-fifth Annual Meeting of the New England Association of Gas Engineers.

OFFICE OF THE SECRETARY, January 11, 1895.

The twenty-fifth annual meeting of the New England Association of Gas Engineers will be held at the Parker House, Boston, on Wednesday and Thursday, February 13 and 14, 1895.

C. F. PRICHARD, Secretary.

[OFFICIAL NOTICE.]

Second Annual Meeting, Michigan Gas Association.

OFFICE OF THE SECRETARY, SAGINAW, MICH., Jan. 23, 1895.

To the Members of the Michigan Gas Association—Gentlemen: The second annual meeting of the Michigan Gas Association will be held in Saginaw, on February 20th, 1895, and will be called to order at 9 o'clock, A.M., sharp. As the meeting is of but one day's duration, it is absolutely essential to begin business early. Please bear this in mind.

The headquarters of the Association will be at the Hotel Vincent, a new and beautifully furnished steam-heated house. Although the house is usually lighted by electricity, arrangements have been made by which our members will not be compelled to use it. The usual rates charged are $2, $2.50 and $3 per day, but it is arranged that a uniform rate of $2.50 will be charged, with a preference to the better rooms.

The meeting of the Association will be held in the parlors of the hotel, and we are promised the best that the house affords. Members and those wishing to meet with us will please write the Secretary engaging rooms ahead of time, for we are to have a very large meeting this year, and it is advisable to house all at the same place.

The following papers will be presented for consideration:

"The Heating Effect of Artificial Lights," by Mr. Henry W. Douglas.

"Federation," by Mr. C. H. Raynor.

"Opposition Gas Companies," by Mr. Joseph Walker.

"Whose Make of Lighting Fixtures Shall We Recommend?" by Mr. W. M. Eaton.

Although the Michigan is yet small in numbers and Saginaw seemingly away out in the woods, it is but three hours' ride from Detroit, and easily reached from all directions. We will therefore expect not only every member, but a great many more who will become members, to meet with us at this time. Very respectfully yours,

HENRY H. HYDE, Secretary.

[OFFICIAL NOTICE.]

February Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, Jan. 26, 1895.

The February meeting of the Guild of Gas Managers will be held at noon of Saturday, February 9th, in Young's Hotel, Boston, Mass.

A. K. QUINN, Secretary.

BRIEFLY TOLD.

OBITUARY NOTE, MR. SYLVESTER S. TOWNSEND.—Last week we were called upon to report the death of Mr. Sylvester S. Townsend, and although his place in the fraternity was not amongst the ranks of the engineering division, nor in connection with the active management of the business of gas supply *per se*, his duties of representing the P. H. & F. M. Roots Company as general agent for that Company's specialties caused him to be well known amongst the gas makers of the country, and particularly so amongst those of the Eastern and Middle States. Sylvester S. Townsend was born at Herricks, Long Island, April 9, 1818, in which hamlet he acquired his education. In 1833 he entered the employ of Messrs. Pentz & Co., a firm which was the acknowledged leader in the drug and dye-stuffs trade of this city, and remained with that house for many years, meeting with great success in his dealings. Among the many friendships that he formed in ordinary course was one eventually destined to change his business career, and that was his intimacy with the Roots brothers, of Connersville, Ind. Going back a bit, we should have said that Mr. Townsend finally succeeded to the business of Messrs. Pentz & Co., and when the business was at last closed out through amalgamation, he retired with a comfortable competence. In 1866 the Roots brothers induced him to represent them in the East as their General Agent. Taking the story on from this point, we cannot better complete the record than by quoting our mention of his retirement from this Agency, which mention was made in the JOURNAL for September 24, 1894: "As Mr. Townsend's business affiliations had not been in a mechanical line, it was only after long persistence on the part of Messrs. Roots that he was induced to represent them in the East. The event proved the Messrs. Roots' sagacity, for Mr. Townsend's business ability in general, added to his energy, wide acquaintance and high standard of commercial integrity, probably contributed more than any other factor to the remarkably extended traffic since gained by the Roots' specialties in everyday commerce. Through Mr. Townsend's instrumentality the Roots' blowers were introduced for innumerable purposes for which the inventors never dreamed they would be adopted. The first pair of Roots' exhausters ever built were constructed at the instigation of Mr. Townsend, who had received an order for them from the Manhattan Gas Light Company, of this city,

and the machines were placed in November, 1870. The construction of the machines was undertaken by the Messrs. Roots much against their own inclinations, but Mr. Townsend's insistence gained the day. * * * * The original pair of machines gave unqualified satisfaction for many years, and were replaced by machines of newer design only because the Manhattan Gas Light Company's needs in time called for larger apparatus on every side. In 1877 Mr. Townsend associated himself with the firm of Cooke & Beggs, who became the Messrs. Roots' selling agents, and their successors (Messrs. Cooke & Co.) are still acting in that capacity." As before noted, Mr. Townsend retired from active business last fall, taking with him the respect and confidence of every man with whom he ever dealt or knew. In 1841 he was united in marriage to Miss Sarah A. Frost, who survives him. He was an active member of the American Gas Light Association, which body he joined at the Washington meeting, October, 1884, and thereafter was a regular attendant at its meetings. And so is closed the life of a man whose course was directed by honor and whose dealings bore the hall mark of probity. In closing, we take the liberty of quoting the following paragraph from a letter to us, written by Mr. E. D. Johnston, Vice-President and General Manager of the P. H. & F. M. Roots Company, announcing the death of Mr. Townsend: " * * * His relations with the brothers, P. H. and F. M. Roots, were more as a brother than as a friend. His integrity was of the highest and broadest type. During 30 years of our business relations his record has been above reproach, even in the slightest details. His was a great and good soul gone out from us, but we shall always revere and honor his memory."

OBITUARY NOTE, MR. PETER COFFEY.—With regret we chronicle the death of Mr. Peter Coffey, Superintendent of the Peoria (Ills.) Gas Light and Coke Company, who passed away on the evening of the 17th inst., after an illness which lasted several weeks. His career well illustrates the possibilities that are within the grasp of the humblest, provided the subject is equipped with common sense and shrewdness, two qualities that Peter Coffey was amply endowed with. He was born in Monoghan county, Ireland, in 1830, and came to this country in 1855, reaching New York with little else than good health and plenty of pluck as his wordly possessions. Here he found employment as a stoker in the works of the New York Gas Light Company, and eventually went to Cincinnati, O., where he found similar employment. St. Louis next attracted his attention as a field of labor, and there he settled down to the acquiring of the trade of a gasfitter. Mastering the trade, his new duties brought him in contact with gas works contractors, which contact enabled him to secure the position of Superintendent to the Belleville (Ills.) Gas Light Company. Of course our readers will easily comprehend that the Belleville of the early sixties was not a center of vast importance, but Mr. Coffey (who had always watched the main chance) was careful, studious and calculating, and the field of his labors was never neglected. Attracted by an advertisement in a St. Louis daily newspaper (we think it was in the fall of 1874) respecting a coming sale at auction of a block of stock in the Peoria (Ills.) Gas Light and Coke Company, he visited St. Louis on the day of the sale and purchased the shares. Resigning his place at Belleville he assumed charge at Peoria, where his record has been that of continuous success. He was of a decidedly practical nature, and although gruff in manner and seemingly pervaded with suspicion, the poor of Peoria have good reason to know that death has palsied to them a hand that often opened to their betterment. His surviving brother (Mr. Thomas Coffey) is President of the Company.

NOTES.—At the annual meeting of the Consolidated Gas Company, New York, the only change in the Board of Directors was that necessitated by the naming of a successor to the late Mr. James W. Smith. The vacancy was filled by the election of Mr. A. Alexander.——Mr. Whittet has introduced a bill in the New York Legislature which directs the repeal of the charter of the Queen City Gas Light Company, of Buffalo.——Mr. Quinn, of Suffolk, Mass., is the sponsor of a bill now before the Legislature of that State, which authorizes "cities and towns to collect an annual charge for the use of public ways by street railway, gas, electric light and telephone companies."——Gas Inspector Meeds has made his first official examination regarding the quality and purity of the gas furnished by the Minneapolis (Minn.) Gas Light Company, and finds that it is up to standard in every respect.——Senator Grady is endeavoring to secure the indorsement of the Pennsylvania Legislature to a bill to create a department for the supervision and regulation of corporations supplying light, heat or power to the public, and to fix the maximum charges and making provision for testing the meters. The bill provides for a Chief Inspector to be appointed by the Governor at a salary of $4,000 and to hold office four years. This official is to appoint six assistants at $2,000 a year, one of whom must be a chemist, and another an electrician. They must furnish the Auditor-General a list of illuminating, natural and fuel gas and electric light and power companies, with full particulars as to their construction and the business done by each. The maximum charge for illuminating gas is to be $1.25 per 1,000 cubic feet, and for natural or fuel gas 25 cents per 1,000 cubic feet, and for electric energy 17 cents per Pennsylvania unit; illuminating gas must be at least 15-candle power. A penalty of $500 is provided for supplying gas of a lower grade. The office of the Inspectors is to be in Harrisburg, with branches in Philadelphia and Pittsburgh. The rules prepared by the Chief Inspector and Insurance Commissioner, in conjunction with the Directors of Public Safety of Philadelphia and Pittsburgh, are to be as binding as acts of Assembly, and violations are punishable by a fine of $500. Meters may be tested upon the request of the consumers, the expenses of the test to be paid by them if found correct, and, if not correct, to be paid by the Company, and new meters must be put in.

The London "Lancet's" Report on Incandescent Gas Lighting.

The London *Lancet*, according to the *Gas World*, has published a report on the incandescent system of gas lighting, which report is the result of the labors of a special analytical and sanitary commission appointed by that eminent medical authority to consider the subject. In their introductory remarks the Commissioners say that the evolution of injurious products of combustion by the crude gas supplied in the early days of the industry threatened to extinguish the system at its inception. "But the introduction of the improved methods of purification and production," the report continues, "saved it from so untimely an end, and spared the life of an industry which is now well nigh indispensable to the existence of the civilized world."

Medicine Benefited by Coal Gas.—Referring to the benefits conferred on medicine by the coal gas industry, the Commissioners say: "It is interesting to reflect how even medicine, if coal gas lighting had not been established, would have been bereft, possibly to the present day, of many of its valuable agents. What antiseptics, for example, are more largely employed or more highly valued in the treatment of disease than the series of phenols obtained exclusively from coal tar? or what more valuable antipyretics, etc., are at the physician's disposal than those which coal tar products have furnished? And what study, again, more than that of these interesting derivatives has given greater impetus to pharmacology in adding to our knowledge of the constitution and structure of bodies, and so enabling us to make remedial measures more scientific and exact? Again, our eyes would never have beheld the endless series of beautiful colors made from coal tar products; and how different would have been the complexion of everything connected with fabric had not coal tar provided us with a starting point from which these things have been obtained! To the idea of utilizing coal gas as an illuminant, therefore, we owe all these benefits; and just as at one time coal gas was the only product of destructive distillation of coal upon which any value was set—whereby, in consequence, so many valuable bye-products were lost—so now investigators have been led to inquire as to whether, by existing methods of lighting, we realize the full value of coal gas as an illuminating agent, or, in other words, whether we extract by present methods all the radiant energy or light which it is capable of giving."

The report then refers to the different types of burners designed to get the full illuminating value of gas; and it is pointed out that all the types—from the fishtail to the regenerative—require a gas of definite illuminating value; and it is stated that "the illuminating value of coal gas varies with a number of conditions, as, for example, the kind of coal employed, the temperature used in distilling it, and so on; but the coal yielding the highest illuminating value is Newcastle cannel (so called because it gives a gas up to the candle power prescribed by Parliament). Now that the supply of this variety of coal is sensibly diminishing, and the demand for coal gas steadily increasing, other coals are used, and the purified gas obtained from them is subsequently enriched with water gas impregnated with highly luminous oil gas." After this rather funny paragraph comes a long description of the Welsbach burner and the principles upon which it is based; and it is stated that this burner "affords an admirable illustration, and is probably the best result ever obtained, of the conversion of heat into light rays." In considering the burner from the health standpoint, the Commissioners regard it as "consisting simply of an ordinary bunsen burner, over the flame of which is suspended a network of incombustible material that is intensely light-giving when raised to the temperature of the bunsen flame."

Comparisons in Relation to CO_2 Produced.—It is recognized that the ultimate products derived from the combustion of a given quantity of gas must be the same in whatever way the gas is burned, but it is pointed out that if an equal light result can be obtained with a less consumption of gas the quantity of products must be less. The following table has been calculated upon this basis, taking the cubic foot of gas as producing 0.52 cubic foot of CO_2 and one human adult as exhaling 0.60 cubic foot of CO_2 per hour:

TABLE I.

Burner.	Consumption in Cubic Feet.	Cubic Feet of CO_2 Evolved Per Hour.	No. of Human Adults Producing same Amount of CO_2 per Hour.
Welsbach (atmospheric burner)	3.5	1.82	3.03
Argand	6.0	3.12	5.20
Bray, No. 5, batswing	6.0	3.12	5.20
Belge oil lamp (16-candle power)	2.08 oz. oil per hour.	2.91	4.85
Hinks' duplex (candle power undetermined)	2.90 oz. oil per hour.	4.00	6.66

The data so obtained were put to a practical test, the results of which are given in the next table. The experiments were made in a very small room, 10 feet long, 10 feet high, and 6 feet wide only, the usual crevices having first been closed. The amount of carbonic acid and the temperatures at two points—one just beneath the ceiling and the other at breathing level—were ascertained before the experiment, and repeated at intervals of an hour, the experiment lasting three hours. Two burners were fixed on the walls at a height of 6 feet, and were 9 feet apart, in opposite corners—that is, at each end of the diagonal. These conditions represent, of course, a very extreme and exaggerated case, owing to the size of the room and the use of two burners in it; but the trials were strictly comparative, and the errors introduced in the analyses and observations were reduced in proportion as the products were greater and the rise of temperature higher. In the last experiment an oil lamp was placed upon a table 3 feet high, as this was considered to represent the actual conditions of practice. The lamp was carefully weighed before and after the experiment, the difference in weight giving, of course, the amount of oil (kerosene) consumed.

Reviewing this table, the Commissioners say that the chief points calling for notice are as follows: "The relative effects of a Welsbach burner with and without a mantle are especially instructive, as affording some information of distinct value as to the chief differences caused by the introduction of a mantle into the flame. The total products should, of course, be the same, since the amount of gas consumed was the same. The mean amount of CO_2, as a matter of fact, was, as the table shows, as nearly as possible identical. But by the introduction of the mantle into the flame it is evident that there occurs a concentration of the CO_2 close to the ceiling, while there is, as we should expect, a corresponding and very decided diminution at the breathing level. We conclude, therefore, that the plain bunsen flame (inclosed in a chimney) produces a quicker and more decided distribution of the burned gases or products in the room, owing, no doubt, to the greater freedom of space around the flame and the consequently increased draught up the glass chimney. On this explanation the introduction of the mantle into the flame would naturally reduce the rate of draught through the chimney. The same is true of the temperature, which after the first hour was raised by the Welsbach burner with its mantle only 6° at breathing level, but in the case of the burner without the mantle it was raised 10°. Indeed, the increase of temperature, as might be expected, appears *pari passu* with the carbonic acid. So far, then, the Welsbach burner is distinctly more satisfactory in its effects upon the air of a room at breathing level than even the plain atmospheric burner. When we look at the effects of the argand and batswing burners, of course the carbonic acid and temperature increase enormously, in accordance with the greater consumption of gas. The argand vitiates the breathing level somewhat sooner than the batswing, in consequence, no doubt, of the impetus given to circulation by the use of a chimney. This is true also of the increase in temperature. Finally the oil lamp effects a gradual and general distribution of both the heat and carbonic acid produced, the amount of these being the same at both the ceiling and breathing level.

"It should be observed, in addition, however, that though with the oil lamp, as might be anticipated, the rise of temperature is not so great as two Welsbach lamps (the proportion of hydrogen in oil, the chief heat-

TABLE II.—*Vitiating and Heating Effect of Various Burners.*

Burner (6 Feet from Floor).	Carbonic Acid (CO_2) Contained in 10,000 Volumes of Air.				Temperature in Degrees Fahrenheit.				Consumption of Gas in Cubic Feet per Hour.
	Original Air.	After 1 Hr.	After 2 Hrs.	After 3 Hrs.	Original Air.	After 1 Hr.	After 2 Hrs.	After 3 Hrs.	
Two Welsbach—									
(a) At 1 foot below ceiling	6.0	67.2	77.9	80.5	53.0	68.0	76.0	81.0	7
(b) At breathing level	6.0	10.5	17.0	18.2	53.0	59.0	63.0	65.0	
(c) Mean result	6.0	38.8	47.4	49.3	53.0	63.5	69.5	73.0	
Two Welsbach without mantles—									
(a) At 1 foot below ceiling	6.0	54.9	56.5	63.1	53.0	75.0	78.0	80.0	7
(b) At breathing level	6.0	23.2	36.8	32.9	53.0	63.0	64.0	65.0	
(c) Mean result	6.0	39.5	46.6	48.0	53.0	69.0	71.0	72.5	
Two Argand—									
(a) At 1 foot below ceiling	6.0	93.1	117.6	119.0	53.0	79.0	84.0	89.0	12
(b) At breathing level	6.0	38.6	48.6	50.2	53.0	65.0	68.0	72.0	
(c) Mean result	6.0	65.8	83.1	84.6	53.0	72.0	76.0	80.5	
Two Batswing Bray, No. 5—									
(a) At 1 foot below ceiling	6.0	84.1	108.2	115.7	53.0	78.0	89.0	95.0	12
(b) At breathing level	6.0	37.6	46.6	47.4	53.0	59.0	65.0	69.0	
(c) Mean result	6.0	60.8	77.4	81.5	53.0	68.5	77.0	82.0	
One Belge oil lamp, 16-candle power (on table 3 feet above floor)—									
(a) At 1 foot below ceiling	6.0	38.7	48.1	53.6	53.0	62.0	65.0	66.0	2.08 oz. per hour.
(b) At breathing level	6.0	23.7	35.3	44.5	53.0	59.0	61.0	63.0	
(c) Mean result	6.0	31.2	41.7	49.0	53.0	60.5	63.0	64.5	

TABLE III.

Burner.	Consumption.	Candle Power.	Increase of Temperature in One Hour per Candle Power.	Increase of Carbonic Acid in One Hour per Candle Power.	Increase of Carbonic Acid per Cubic Foot of Gas Consumed.	Increase of Temperature per Cubic Foot of Gas Consumed.
Two Welsbach	7	50 + 40	0.116°	0.365	4.8	1.5°
Two Argand	12	16 + 16	0.590°	1.900	5.0	1.5°
Two Batswing, Bray, No. 5	12	9.6 + 9.6	0.807°	2.86	4.6	1.3°
One Belge Oil Lamp	2.08 oz. oil per hr.	16	0.468°	1.56	—	—

TABLE IV.

Burner.	Blood Test (Carbon Monoxide.)	Palladium Chloride for Carbon Monoxide in Previous Blood.	Ammonia Silver Nitrate Test for Acetylene.
Two Welsbach burners without mantles = atmospheric burner, consumption 7 cu. ft. per hour	Negative.	Negative.	Negative.
Two Welsbach burners (complete), consumption 7 cu. ft. per hour	Negative.	Negative.	Negative.
One Argand burner, consumption 6 cu. ft.	Negative.	Negative.	Negative.
One Bray Batswing, consumption 6 cu. ft.	Slight indication.	Slight indication.	Doubtful.

producing constituent of coal gas, being relatively small), yet the mean amount of carbonic acid produced was almost exactly the same after three hours; so that the vitiation of air with carbonic acid gas by one Welsbach burner giving over 50-candle power light and consuming 3½ cubic feet of gas is less than one-half that produced by an oil lamp of 16-candle power, and consuming a little over 2 ounces of oil. We have here a striking fulfilment of the requirements of theory as stated in Table I., and therefore some distinct evidence of the accuracy of the experiments."

Vitiation and Heating per Candle Power.—The next table is partly derived from the immediately preceding one, and shows the increase in carbonic acid and temperature in one hour per candle power and per cubic foot of gas consumed. We give it above in a condensed form. (See Table III.)

Referring to the above, the Commissioners say that they cannot ignore the fact that, quite apart from the economy of gas and the increased light value secured, the Welsbach burner affects the atmosphere far less for evil, judging from the carbonic acid and heat, than any other existing type of burner. Concerning the figures in the two last columns in the table, it is pointed out that they should accord with each other, and that, as a matter of fact, they are "as close as the conditions of the experiment may be expected to allow."

Searching for Unburned Gases.—The next stage in the inquiry was a search for unburned gases, such as carbon monoxide and acetylene, "which, if found, howbeit in small traces, would afford emphatic ground for objection to the general adoption of a burner from which these poisonous products are shown to escape." In this test the ordinary conditions were exaggerated, so as to make it more severe. The experiments were conducted as follows: "The burners (in the case of the Welsbach, two in number, but of the rest only one) were lighted and placed in a small chamber 3 ft. 1 in. by 3 ft. 1 in. by 2 ft. 4 in. (with no provision for any appreciable ventilation or outlet for the gases) for eight hours, during the whole of which time the air taken from above the burners was aspirated, first over potash and soda lime to remove carbonic acid and sulphur compounds, then through sulphuric acid to remove ammonia, and, finally, through a dilute solution of blood. At the end of eight hours the experiment was stopped, and the blood examined with a delicate spectroscope. To preclude any doubt whatever as to the presence of carbon monoxide, the blood was further treated in the following manner: Fresh air was caused first to pass through a solution of palladium chloride, to remove organic or other chance impurities, then through the blood, the temperature of which was gradually raised by means of a water bath, and, finally, through a third tube containing chloride of palladium. Any carbon monoxide absorbed by the blood during the aspiration of the combustion gases would thus be displaced, and would cause a darkening in the palladium solution, due to separation of the metal. Acetylene was also searched for, the solution of ammoniated silver nitrate being employed for the purpose."

The results of the tests are given in Table IV.

It is added that "even when the gases were aspirated for hours straight from the chimney of the Welsbach burners neither of the poisonous gases, carbon monoxide or acetylene, could be detected."

Loss of Light by Chimneys.—The examiners next directed their attention to the loss of light in the Welsbach caused by the use of different chimneys. A new lamp with a glass chimney gave 60 candles, against the pentane standard, with a consumption of 3 cubic feet of gas; the same lamp with a mica chimney and a consumption of 3.5 cubic feet gave 56 candles, and another test with 3 cubic feet gave 50 candles; the same lamp with an amber glass chimney and a consumption of 4 cubic feet gave 52 candles; the same lamp with a ruby chimney gave 27 candles with 4 cubic feet and 30 candles with 3 cubic feet; and the same lamp with a red chimney gave 50 candles with 3 cubic feet and 60 candles with 4 cubic feet. The loss of efficiency per cubic foot of gas was, with a mica chimney, 1.01 and 3.33, with an amber glass chimney 2, with a ruby chimney 8.25 and 10, and with a red chimney 3.33 candles.

Conclusions.—In the course of their concluding remarks, the Commissioners say: "Like the electric arc light, the Welsbach incandescent light is very rich in the violet or active chemical rays of the spectrum, and it has consequently a low diffusive power; but, on the other hand, it serves very effectually as a source of artificial light for photographic purposes. It is also excellently well adapted for the illumination of objects on the microscopic slide, and for certain operations in analytical chemistry in which change of color is taken to indicate chemical change. Owing, again, to its extreme brilliancy, it proves an excellent search light for the exploration of the larynx, fauces, or nasal cavities.

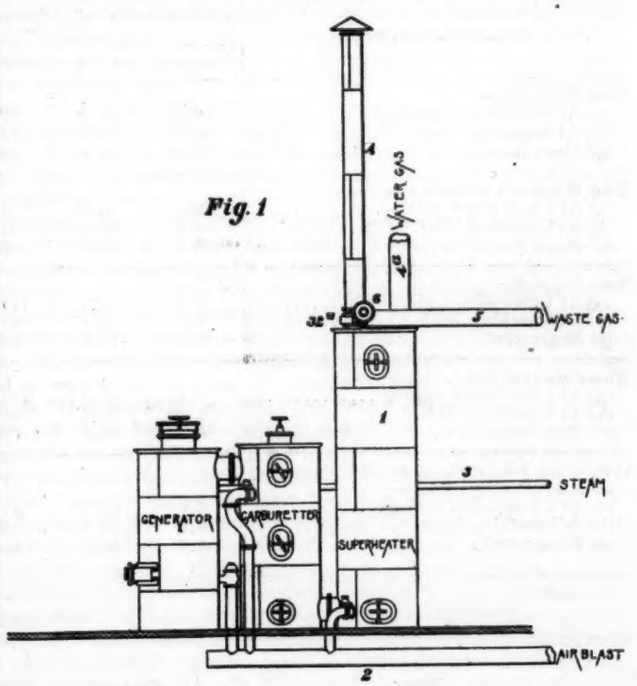
"In considering the systems of artificial lighting that are in vogue at the present time, the incandescent system of electric lighting must, of course, rank first from the point of view of health, since it affords a soft, agreeable light, without giving rise to any vitiation of the air; there is no combustion, and consequently there are no products of combustion, complete or incomplete. From the same point of view we are bound to place next, in the face of the result of our present inquiry, the incandescent gas light in its improved form. It is even less productive of carbonic acid gas than the average oil lamp, and consumes not quite one-half less gas than the existing type of burners, giving rise, therefore, to the evolution of half the heat and half the amount of carbonic acid gas while its illuminating power, expressed in candles, is more than three times as great as the best ordinary gas burners or the incandescent electric lamp, each of which does not generally exceed 16-candle power, unless a very great expense is no object to the consumer. We are far from saying that the incandescent system of gas lighting has attained to the highest pitch of perfection; still we are well within bounds when we regard it as the system of gas lighting which utilizes most efficiently and most economically the full powers or duty of coal gas as an illuminating agent."

Rusby's Water Gas Apparatus.

On the 15th inst. U. S. Letters Patent (No. 532,586) were granted to Mr. John M. Rusby, of Jersey City, N. J.—he subsequently assigned his rights to the United Gas Improvement Company—for an improved water gas apparatus. Using the words of the specification:

One object of my present invention is to effect an economy or saving and to provide for the utilization of so much of the waste heat of a water gas generating plant as is necessary under various existing conditions for heating the air blast or blasts to any required or predetermined

Fig. 1



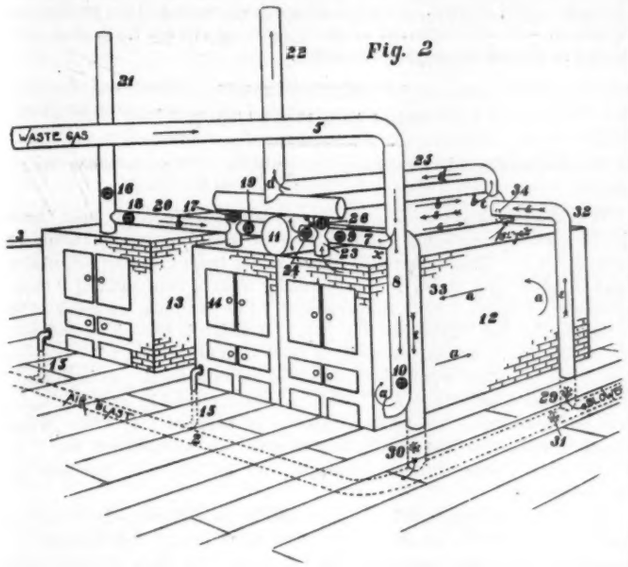
temperature and further to provide for the utilization of the balance or remaining portion of the waste heat for generating steam; and to this end my invention consists of the improvements hereinafter described and claimed.

The nature, characteristic features and scope of my invention will be more fully understood from the following description taken in connection with the accompanying drawings forming part hereof and illustrating one embodiment of my invention, and in which Figure 1, is an elevational view illustrating portions of a well known type of water gas generating apparatus commonly designated "the Lowe apparatus," and Fig. 2 is a perspective view of boilers and an air heater for use in connection with the portion of the apparatus shown in Fig. 1, and these two figures taken together illustrate a plant embodying features of my invention. Fig. 3 is a sectional view drawn to an enlarged scale and illustrating a flap valve shown in Fig. 1, at the junction of the stack and waste gas conduit. Fig. 4 is a vertical sectional view illustrating the by-pass shown in Fig. 2, and adapted to afford means whereby any

required portion of the waste gas may be directed to an air blast heater and whereby the balance or remaining portion of the waste gas may be directed to a boiler or boilers; and Fig. 5 is a horizontal sectional view illustrating a modified form of by-pass wherein the waste gas is supplied to the air heater without mingling with waste gas that has traversed the boiler and that is escaping therefrom into the boiler off-take.

In the drawings 1 designates portions of one type of water gas generating apparatus of the "Lowe" class provided with any suitable air blast connections 2, steam connections 3, and main 4a, for conveying away the so-called water gas that is generated and intended for preservation and use. During the operation of heating up such an apparatus

Fig. 2



preparatory to the manufacture of so-called water gas, fuel is consumed in the generator usually under the influence of a forced draft, and the highly heated waste gas resulting from this combustion is discharged usually from the top of the superheater as shown, although in some instances it is also discharged from other parts of the apparatus, for example, from the carburetor, and my present invention is applicable to any type of such apparatus, the point of the apparatus from which the waste gas is led off being immaterial, the apparatus shown being selected merely for purposes of illustration.

The waste gas given off or discharged from the apparatus shown in Fig. 1, while it is being heated up for the manufacture of water gas, is utilized advantageously and economically according to my invention, because the air blast may be heated to any required temperature by a portion of it and because the balance of it is utilized for generating steam which is supplied to the apparatus, more especially during the generation of useful gas or "water gas," as it is commonly designated.

During the operation of heating up the apparatus shown in Fig. 1, the waste gas is in whole or in part, usually the former, prevented from escaping at the stack 4, and is directed into a waste gas conduit 5, by means of any suitable valve or valves for controlling the opening or passage through the stack 4 and conduit 5. For purposes of illustration, Figs. 1 and 3, a flap valve 6 is availed for this purpose, and this flap valve may be caused to completely interrupt the passage of waste gas through the stack 4, as shown by full lines in Fig. 3, or through the waste gas conduit 5, as shown by dotted lines in said figure. Moreover, this flap valve may be placed in a position intermediate of those above mentioned in order to direct so much of the waste gas to the conduit 5 as is necessary or desirable for heating air and water, and the remainder thereof to the stack 4, to permit of its escape therethrough. The conduit 5 leads to a by-pass 7—8, whereby so much of the hot waste gas may be passed through the part 7 and air heater 11 as is necessary or requisite under existing conditions for heating the blast to the temperature required under the existing conditions for attaining the most economical and beneficial results in the apparatus shown in Fig. 1. In this connection it may be remarked that the quantity or proportion of the heat of waste gas that should be imparted to the air blast varies according to the quality and kind of fuel employed in the apparatus shown in Fig. 1, and according to other conditions that will be readily understood by gas makers, and that determine for the time being the most economical temperature at which the blast may be employed.

To provide for increasing or diminishing the quantity of the sensible heat of the waste gas utilized for heating the air blast, or in other words, to provide for increasing or diminishing at will the temperature of the air blast, use is made of a valve or valves. As shown, two valves, 9 and 10, are employed for this purpose, but a flap valve like that shown in Fig. 3, and hinged as at x, Fig. 2, might be employed in lieu thereof. For the sake of explanation it will be assumed that the valves 9 and 10 are partly open, and in order to increase the temperature of the air blast the valve 9 is opened and the valve 10 is closed either wholly or in part according to the increase of temperature required, whereby an additional quantity of waste gas is directed from the conduit 5 to the heater 11, with the result that the air blast is heated to a correspondingly higher temperature. Conversely the opening of the valve 10 and closing of the valve 9 causes a diminished quantity of waste gas to be delivered to the air heater 11, whereby the temperature of the air blast is correspondingly decreased.

In all cases the portion of the waste gas which is not employed for heating the air blast in the heater 11 is directed through the part 8 to the boiler 12, through which it circulates, for example, in the direction indicated by arrows a, in Fig. 2, in order to give up its sensible heat for the purpose of generating steam, which in turn is supplied by means of the connections 3, to the apparatus illustrated in Fig. 1.

13 and 14 represent additional boilers of the same tubular type as boiler 12, and which may or may not be employed. Within the boilers 13 and 14, when present, there is maintained a combustion of suitable fuel, and this combustion is controlled by air blasts supplied from the

Fig. 4

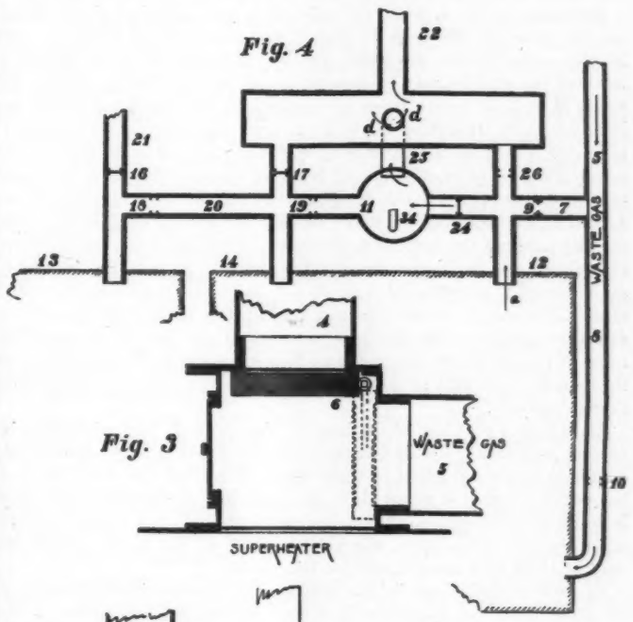


Fig. 3

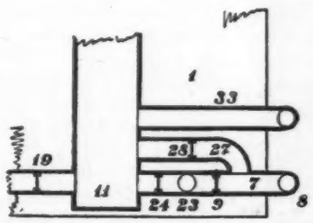


Fig. 5

air blast pipe 2, through branch pipes 15, that may be provided with automatic damper regulators that control the passage of air through them, and that are governed automatically to maintain the required pressure of steam. The heated products of combustion from the boilers 13 and 14 may, by closing the valves 16 and 17, and opening valves 18 and 19, be caused to traverse the conduit 20 and air heater 11 in the direction indicated by the arrows b, in order to impart their sensible heat to the air blast. In this connection it may be remarked that the air heater may resemble in construction a tubular boiler, and that the products of combustion from the boilers 13 and 14, may be caused to traverse one set of tubes in the heater 11, while the waste gases issuing from the part 7 are caused to traverse another set of tubes in the heater 11, although the employment of one or two sets of tubes in the heater 11 is a matter of construction. By closing the valves 18 and 19, and opening the valves 16 and 17, the products of combustion from the boilers 13 and 14 may

be permitted to escape through the off-takes 21 and 22, without entering the air heater 11. The waste gases, after traversing the boiler 12, and after having been deprived of at least a portion of their sensible heat for the generation of steam, escape through the pipe 23, and as shown in Fig. 2, mingled with the waste gas traversing the part 7, and the resultant mixture passes the valve 24, which is open for this purpose, and escapes through the air heater 11, as is indicated by the arrows *c*. From the air heater 11 the comparatively cool gases escape, in the present instance, through a pipe 25, into the off-take 22, as shown by the arrows *d*. However, if the temperature of the gases traversing the pipe 25 will warrant it, this pipe may be replaced by an additional air heater. By closing the valve 24, and opening the valve 26, Fig. 4, none of the waste gas is passed through the heater 11, although either all or a part of it, according to the position of the valves 9 and 10, passes through the boiler. In such case, the air heater 11 may be heated wholly by means of the products of combustion from the boilers 13 and 14.

Although horizontal tubular boilers are illustrated in the drawings, still my invention is obviously applicable to boilers of a vertical type, and in such case the air heater may also be disposed vertically and made to stand upon its end on the boiler.

It will be observed that, as shown in Fig. 2 and above described, the waste gas passing through the pipe 23, after having been deprived of at least a part of its sensible heat in the boiler 12, unites and commingles with hot waste gas traversing the part 7, on its way to the air heater 11. In Fig. 5 I have illustrated a separate connection 27 and valve 28, whereby this commingling of hot and partially cooled waste gas before entering the air heater is obviated.

Referring to Fig. 5, when the valve 28 is open and the valve 9 closed, the hot waste gas traverses the part 27 and enters the air heater 11, and in this construction the waste gas which issues from the boiler 12, through the pipe 23, may be directed to the off-take 22, by closing the value 24, so that under these circumstances the waste gas which has been cooled by traversing the boiler 12 does not enter the air heater 11, although it may be caused so to do by closing the valve 26, Fig. 1, and opening the valve 24, Fig. 5. Air is forced into air conduit 2, by means of a blower or other suitable device not shown, and by closing the valves 29 and 30, and opening the valve 31, this air would be caused to pass directly through the conduit 2. However, this is not done, but the valve 31 is closed and the valves 29 and 30 are opened, so that the incoming air is caused to traverse the pipes 32 and 33 and space between the tubes of the air heater 11, in the direction indicated by the arrows *e*, and in a direction opposed to the direction of travel of the hot gas through the tubes of the air heater. From the air heater hot blasts of air are supplied through the conduit 2 to the apparatus illustrated in Fig. 1, in any well known manner.

32a is a door provided at the base of the stack 4, and adapted to be opened periodically by the gas maker in order that he may examine the condition of the out-going or waste gas. Moreover, the door 32a may be opened in order to admit air to the waste gas so that the latter may be burned before entering the boiler 12. If there is not sufficient draft when the door 32a is open, the natural draft of the boiler off-take 22 may be aided by a small steam jet injector 34.

Various modifications in the manner of constructing and working the above described apparatus have been referred to. However, a description will now be given of its usual mode of operation.

While the opparatus is being heated up preparatory to the generation of water gas, the conduit 4a is closed, the flap valve 6 is turned into the position indicated by full lines in Fig. 3, for directing waste gas from the apparatus shown in Fig. 1, through the conduit 5. And in this connection it may be remarked that when water gas is being generated, the stack 4 is open and the flap valve 6 is in the position indicated by the dotted lines in Fig. 3 for closing the conduit 5, so that any water gas that may leak from the superheater will pass through the stack 4 into the air. Moreover, the valve 6, when in this position, prevents the ingress of cold air by way of the stack 4 to the boiler 12. From the conduit 5 so much of the waste gas as is necessary for heating the blast to the temperature necessary or desirable for producing the best results in the apparatus shown in Fig. 1 is passed through the bye pass 7 directly to the heater 11, where its sensible heat is given up to the current or blast of air traversing the pipes 32, 33 and 2. The remaining portion of the waste gas is led by the pipe 8 into and through the boiler 12, in which it imparts at least a part of its sensible heat for the generation of steam, which, together with the steam generated by the boilers 13 and 14, is supplied to the apparatus shown in Fig. 1. Moreover the gas maker may raise or lower the temperature of the air blast at will and in the proper manner for securing the most economical and beneficial results under the existing conditions, such as quality of fuel, condition of fire, and the like, by the simple operation of changing the apportionment of waste gases between the air heater and boiler through the intervention of the bye-pass 7—8, and its complemental valve or valves. The hot gaseous products from one or all the boilers, including the partially cooled waste gas from the boiler 12, may be passed through the air heater 11, as has been already described, or, if preferred, these last mentioned gaseous products from one or all of the boilers may be permitted to escape through the off-takes 21 and 22 without traversing the air heater 11. In such case the air heater is heated wholly by means of hot waste gas traversing the part 7.

It will be obvious to those skilled in the art to which my invention relates that modifications may be made in details without departing from the spirit thereof. Hence I do not limit myself to the precise construction and arrangement of parts hereinabove set forth and illustrated in the accompanying drawings.

What Is a Heat Unit?

The *Locomotive*, in answering the question "What is a heat unit?" says:

When, in ordinary conversation, a person uses the word "heat," there is often some uncertainty about the precise meaning that he intends to convey by it. This uncertainty arises partly from the many figurative meanings of the word, but principally from a confusion of "heat," properly so-called, with "temperature." For example, we speak of the "heat of the day," meaning that part of it which is hot—*i. e.*, the middle of the day. Again, we speak of the "heat of a furnace"—meaning really the temperature of the furnace. In the expression "animal heat," on the other hand, the word "heat" is possibly used in its strict sense, and we understand it to mean a quantity of some sort or other, which could be measured just as definitely as wood or potatoes can be, if we could only devise some appropriate unit by which to perform the measurement.

In order to get a somewhat clearer idea of the difference between heat and temperature, let us consider a tub of hot water. A thermometer immersed in this water reads (say) 200° F.; and under these circumstances many persons would say that the water "contains 200° of heat." Now nothing could be more misleading nor more erroneous than such a statement as that. It should be observed that the only thing we have determined is the temperature of the water, and the thermometer would read just the same whether the tub contained a pint of the water or 40 gallons of it, or a thousand oceans of it. If one should find that a thermometer plunged in the Atlantic ocean gave just the same reading as a similar one immersed in a gill measure, he surely would not say that the gill of water in his hand contained as much heat as the whole Atlantic ocean. His observation would indicate that the temperatures of the two were alike, but that is all.

In order to determine the amount of heat in a given body of water, we must first decide upon some convenient unit of heat, and then we must find out how many of these units would be required to raise the given mass of water from the freezing point to the given temperature. For example, we might adopt as our unit of heat, the heat required to melt 1 pound of ice, and we could then determine how many pounds of ice the given mass of water could melt in cooling from the observed temperature down to the freezing point. This method of procedure is quite satisfactory for laboratory purposes, and various forms of apparatus have been devised for putting it into practice, some of which enable us to measure quantities of heat with great precision. Valuable as these "ice calorimeters" are in the laboratory, they are of little or no use to the engineer, because ice is often expensive and difficult to obtain, and because the apparatus necessary to insure accuracy in measuring large quantities of heat by this method would be so cumbersome that it could not be transported from place to place.

For general use in engineering we are obliged, therefore, to adopt some other unit for heat measurement. We might, for example, define a "unit of heat" as the quantity of heat required to raise the temperature of a pound of some given substance one degree, and, in fact, this is the kind of unit that is actually used in practice. We could base the proposed unit on any substance we choose, but as water is both cheap and convenient, and as it can nearly always be obtained in a condition of reasonable purity, it has been adopted by universal consent, and a "heat unit" is defined to be that quantity of heat which will raise the temperature of one pound of water one degree.

Before we could adopt any such general definition as this, we should have to find out whether or not it takes the same quantity of heat to raise the temperature of a pound of water from (say) 39° to 40° that it

does to raise it from (say) 210° to 211°. If this is not the case, it will be necessary to modify our definition of a "heat unit" to the extent of specifying at what temperature the pound of water is to be taken. To guard against a possible ambiguity of this kind, some writers define a heat unit as "the quantity of heat required to raise the temperature of a pound of water from 39° to 40°," while others define the temperature range to be "from 32° to 33°," and others "from 59° to 60°."

In order to judge of the importance (or unimportance) of specifying the temperature of the water in defining the heat unit, let us examine some of the experimental data that have been obtained relative to this point. If the heat required to raise the temperature of a pound of water 1° were the same, all the way from the freezing point to the boiling point, it would follow that if we should stir together 2 pounds of water, one of which is at 212° and the other at 32°, the temperature of the mixture would be $\frac{212° + 32°}{2} = 122°$, and conversely, if the temperature of the mixture is found to be different from 122°, we should know that the quantity of heat required to raise the temperature of a pound of water by 1° is not the same at all points on the thermometer scale. Careful experiments, performed after taking all possible precautions against loss of heat by radiation and conduction, have shown that when a pound of water at 212° is mixed with a pound of water at 32°, the temperature of the mixture is 122.29°. This shows that the quantity of heat required to raise the temperature of a pound of water 1° is not the same at all points of the thermometer scale, but it indicates at the same time that the total variation between the freezing point and the boiling point is very slight. Similar experiments, made by mixing water at other temperatures, give this same result, and hence we conclude that although a "heat unit" is not the same at all temperatures, the variation in its value is so slight that for most purposes it can be neglected. In calculating tables of the properties of steam and water, allowance is made for the fact that the "specific heat" of water is not the same at all temperatures; but in all the ordinary work of testing boilers and engines, and laying out steam plants and heating systems, it is customary to consider the specific heat of water to be constant, and the "heat unit" is defined simply as "the quantity of heat that will raise the temperature of 1 pound of water 1°."

When we say that a pound of steam in condensing gives out 967 heat units, we merely mean that it gives out an amount of heat that would be sufficient to raise the temperature of 967 pounds of water 1°, or 96.7 pounds of water 10°, or 9.67 pounds 100°, etc. Similarly when we say that a pound of good coal gives out 14,000 heat units when burned, we mean that each pound of the coal can heat 14,000 pounds of water 1°, or 1,400 pounds 10°, or 140 pounds 100°, etc. And finally when we say that the "mechanical equivalent of heat" is 779 foot pounds, we only mean if a weight of 779 pounds should fall 1 foot, the work it would do would be just sufficient to raise the temperature of a pound of water 1°; and conversely, if we could utilize (by means of a steam engine or otherwise) all the heat that a pound of water gives out when it cools 1°, this heat would be just sufficient to raise a weight of 779 pounds through a height of 1 foot.

About Chimneys.[1]

It is difficult to understand how the ancients in the northern countries managed to live in habitations in which there were no chimneys, for it is quite evident that the fuel they made use of for heating and cooking purposes threw off as much smoke and gas as the same fuel used to-day; yet we know that the better class of houses were made comfortable in cold weather by being heated artificially. True, it is on record that—under the Romans at any rate—large brick furnaces were built as additions against one of the outside walls, and ducts were left in the wall leading to the space between the floors, which was honeycombed and built, doubtless, of bricks or terra cotta, and made fireproof. The floors being of tile, and the ceilings of large slabs of marble or low arches supported on columns. The smoke and heat by this device passed through the house between the floor and ceiling, thence up the side wall opposite to the furnace, through ducts to the next floor, where the same conditions obtained; then up the side wall over the furnace and out through openings under the eave. Houses heated this way may still be found in North Persia, Manchuria and Northern India. This mode of heating could be, at best, but a makeshift, because of well known conditions connected with the draft of chimneys. Possibly the houses were so arranged that the outlets for the smoke were placed on the opposite side from whence came the prevailing winds. Of course, having no openings into the building, there would be no inconvenience from smoke, but we fancy the temperature must have been such as to require repeated change of clothing. So far as the writer is aware, no example exists of a building arranged for heating by this method, that has come down to us from the Roman period, and the examples spoken of as existing in Asia are poor specimens, and afford no data on which to construct a theory that might explain the manner of the Romans. Of one thing, however, we may rest assured, the Romans, who were the most thorough builders of antiquity, excepting, perhaps, the Egyptians, got the best possible results obtainable by this method of heating.

During the early middle ages, so far as we can learn, there were no chimneys in use in Europe, the rooms and halls being heated with charcoal burning on braziers, and even to-day the brazier is a common sight in Italy and Spain, where many of the houses, palaces and public buildings, that date back three or four hundred years, have no chimneys, and where modern innovators have not been permitted to improve by putting in such appendages as chimneys.

The first appearance of our modern chimney, so far as we can discover, was placed in Rochester Castle about the year 1130, and it is in this building where the first complete open fireplaces were built, though, as a matter of fact, Italy claims that chimneys and fireplaces originated with her, though she has no tangible evidence to exhibit in proof of her claim, while in England many examples exist, dating from the twelfth century; one, that in the great guard room of Curisborough Castle, dating back as far as the early part of the eleventh century, as it bears on its face evidences of having been erected during the Anglo-Saxon period; yet, this fireplace has no chimney such as we know. In place of a chimney there is a flue or duct leading out to the outside of the wall some 25 or 30 feet above the top of the fireplace.

Doubtless it was this sort of flue that led to construction of the chimney as we now possess it, the flues being built in the walls, the thickness of which was ample to admit of pretty large flues. At first these flues terminated on the top of the wall and were topped off with hoods, arches, cowls and other devices, but it was not long before mediæval builders carried the flue a considerable distance above the walls, then the architect's opportunity arrived and he at once accentuated the projection and made it an ornamental feature of the building to which it belonged, and to-day most of our best forms of chimneys are copies taken from the works of these old designers.

In this country the chimney has not received the attention it gets in the Old World, though we are gradually getting into line, and many of our recent buildings that make any claim to pretension are surmounted with fine examples of chimney architecture.

While chimneys were in use during the twelfth century in some of the better class of buildings, they were not at all common, for we read that as late as the sixteenth century, Lelande, an author of some note, in writing of Bolton Castle, says: "One thynge I muche notyd in the hawle of Bolton, how chimeneys were conveyed by tunnells made on the syds of the walles betwyxt the lights in the hawle, and by this means, and by no covers (cowls), is the smoke of the harthe in the hawle wonder strangely conveyed." Evidently this was the first hearth and chimney Lelande had seen, which is proof of their scarcity in England, for he was more than an ordinary individual and "went muche with the gentlemene in my shire," as he himself puts it. In fact, chimneys did not come into common or universal use until the commencement of the eighteenth century.

The philosophy involved in the operation of a chimney depends altogether on the principle that a column of heated air is lighter than a cooler column of like dimensions. This being admitted, it follows that the lighter air will be forced upward by the heavier, just as a body lighter than water will be forced to the surface by the action of the heavier body. It is this action, caused by the difference of density, that establishes a current or draught. All other conditions being equal, the draught of a chimney is thus proportional to its perpendicular height, and, of course, the difference in temperature within and without the flue. The straighter and taller the shaft, the more powerful will be the ascending current; but there are cases, no matter how straight or how lofty the chimney may be, that will refuse to conduct the smoke through its length under certain mysterious conditions. Some causes of chimneys smoking are well known and avoidable, the trouble arising perhaps from positive ill-construction, having a narrow part, an ugly bend, or a downward portion in their conduit, which their normal draught is not sufficient to overcome. Others smoke because they form the shortest channel by which the air can enter the house to supply the draught of a higher chimney. When there are two chimneys in one room, or in rooms adjacent to each other, and the doors and windows are closed in all other rooms, the shorter chimney will draught inwardly to supply the loftier one with a current.

1. By Mr. Fred. T. Hodgson, in *Architecture and Building*.

Sometimes the best constructed and most wisely designed chimney with regard to the building in which it is situated, will smoke in consequence of its exit being in the immediate neighborhood of walls, hills or trees, whose situation is such as to create at times strong eddies and cross currents. In most cases, however, the addition of a few feet or so to the height of the chimney shaft, supposing it to be already above the ridge of the house which it ventilates, will prove more useful than any addition of those curiously contorted and usually non-pneumatic contrivances that are so often planted on the top of a smoky chimney to cure it of its "cussedness."

Apart from the questions of normal draught, and of internal regularity of construction, is the effect of wind on the draught of chimneys. This varies very much with the locality of the house. The action of wind, although, of course, always determined by physical laws, is so subtle and so delicately affected by slight causes that there are many cases in which it is impossible to foretell it. What is more common than to have a chimney that has been built in full accordance with all the rules relating to chimneys, and which answers its purpose perfectly well, except when the wind is in one particular point of the compass? And why does it then smoke? To be able to reply to this question is to be able to cure the defect; but how often is the difficulty regarded as insuperable? The celebrated American philosopher, Count Rumford, paid great attention to the subject of smoky chimneys. He says, writing on this subject: "Those who will take the trouble to consider the motion and properties of elastic fluids of air, smoke and vapor, and to examine the laws of their motions, and the necessary consequences of their being rarefied by heat, will perceive that it would be as much a miracle if smoke should not rise in a chimney—all hindrances to its ascent being removed—as that water should refuse to run in a siphon or to descend in a river. The whole mystery, therefore, of curing smoky chimneys is comprised in this simple direction: Find out and remove those local hindrances which forcibly prevent the smoke from following its natural tendency to go up the chimney, or rather, to speak more accurately, which prevent its being forced up by the pressure of the heavier air in the room."

It is on record that Count Rumford prescribed for and cured more than 500 chimneys that had been given up as incurable, and his services were in constant demand whenever he was disposed to render them.

In Southern Italy, the land of "master builders," all chimneys are built over with some sort of roof, either arched or run up to an acute angle, and no architect ever thinks for a moment of leaving a vertical flue open at the top to receive the tremendous downpour of rain which occasionally occurs in that sunny land. The covering of the chimney, whatever it may be, has a number of apertures in its sides for the escape of smoke, and these openings are so constructed that the wind striking against them receives an upward tendency, as the bottom, or lower portion of the aperture, slants outward similar to a louvre board. By this method of construction two objects are attained, the slant carries the wind upward and thereby increases the draught by suction, and it prevents the water from finding its way down the flue.

There are few mathematical formulæ extant for the guidance of builders as to the height or draught of chimneys. It may, therefore, be of some service to give the following simple rule, prefacing the formula with a statement of the principles on which it is founded.

We already are aware that warm air is lighter than cold, and that it is this fact that causes a "draught" when the chimney is in service. This difference of weight must be enough to overcome the friction within the flue and any resistance to free discharge at the top. It is obvious that the ascending volume consists of matter which at equal temperatures is heavier than atmospheric air, as it contains soot or finely comminuted carbon, carbonic acid, sulphur, and other matters naturally heavier than air. Calling attention to these two sources of retardation, namely, friction and the loading of the column, it will be safe to neglect them in tabulation, as it is very difficult to determine the absolute heat of the ascending column, and a few degrees more or less will amount to quite as much as the neglected elements. With this explanation the formula that regulates draughts may be stated thus: $D = (a\ t \times a\ t^1)p$. Where D = the draught, $a\ t$ the weight of a cubic foot of atmospheric air, $a\ t^1$ the mean temperature within the shaft, and p the height of the chimney. It is obvious at a glance at this formula of how much importance the addition of a very few feet to the height of the chimney must be.

To increase the draught we must increase either p, the height of the chimney, or t^1, the temperature of its contents. This explains at once the efficacy of the best appliances for increasing draught. The more the air that enters below is compelled to pass through in close proximity with the burning fuel, the higher does t^1 become and the more powerful the draught. This is the simple key to the whole theory and practice of draught produced by heat. Of course, in different conditions of the barometric column equal amounts of heat will have somewhat different effects. Hence we can see in a moment why our fires burn better in clear, cold weather than when the air is warm or loaded with damp. The weight of a cubic foot of air at 32° F. is 0.080728 lb. avoirdupois.

One common cause for smoky chimneys that seems to defy all ordinary treatment is the absence of provision for sufficient inlet of colder air within the room. Thus, rubber weather strips and other draught-preventing contrivances may, and often do, make chimneys smoke. It is absolutely necessary that the inlet of air to the fireplace be in a certain proportion to the capacity of the grate and the chimney. When, as sometimes occurs, the air enters the apartment solely on the same side as that on which the fireplace is situated, the draught produced is likely to make the chimney smoke. The air inlet should always be opposite the fireplace to insure a perfect and steady draught; indeed, this is a matter that really belongs to ventilation—a matter of prime importance—and is even now but imperfectly understood in the construction of many of our best buildings.

It has been proved beyond a peradventure that a circular flue possesses greater facilities for a perfect draught than flues having more or less angles; hence where possible it is better to make the flues as near circular in form as conditions will admit. In many instances ordinary drain tiles have been built in a square flue with perfect success, and as the cost of these drain pipes is not very great a safe and efficient chimney can be constructed by using them at a very small percentage of added cost. All flues not having a circular lining of some sort should be well "parged" with good mortar throughout their whole length, and the "parging" should be made as smooth as a trowel can make it, so that there will be no ridges or roughness for soot to gather on or to prevent the upward course of smoke. "Parging" also tends to make a chimney stronger and safer, preventing fire from eating its way through the mortar joints to woodwork, and protecting in some measure the joints themselves from the destructive action of the gases that generate from the combustion of coal. Frequently that portion of a chimney which is exposed to the atmosphere bears evidence of the mortar leaving the joints, owing to the action of sulphuric acid on the lime and silicate, decomposing the lime into calcium sulphate, carbonic acid and water, which are easily washed out by heavy rains, leaving nothing but sand in the joints to bind the bricks or stones together. If this disintegration ended on the outside of the building it would not be so bad, but as a matter of fact it often extends below the roof, and is no doubt the cause of many a fire the origin of which was undiscoverable. By the use of tile linings this danger is avoided, but when the pipes are not taken advantage of it is a good idea to have the work—brick or stone—laid in Portland cement, as the gases do not act upon it in the same manner as they do on mortar made from common lime.

All of the foregoing relates more particularly to chimneys for domestic purposes, or which are used solely for heating dwellings or halls where people congregate; but chimneys that are intended for manufacturing purposes require some little different treatment, and we purpose at this stage to see wherein and why they differ from the ordinary chimney.

It is stated that the tallest chimneys in the world are those that were built in Glasgow, Scotland, some years ago to carry off the noxious fumes from several chemical works and dump them into the higher atmosphere, where there would be no danger of poisoning people. The tallest of these chimneys is 456 feet high, independent of its foundation, which would make it some 30 feet taller. One of the tallest chimneys in the United States is in East Newark, N. J., and is built in connection with the thread mills of Clarke & Co. It is a current idea that a tall chimney does not form a very pleasing feature of architecture; but this is not true of the Newark chimney, for a more graceful column—for such it is—can scarcely be found in the country, and a comparison between it and some of the memorial columns we wot of would result quite favorably for the chimney.

To design and build a successful factory chimney requires more architectural skill and scientific knowledge than most practitioners usually lay claim to, for if it is intended to take away the gases or fumes from retorts and furnaces, it must be built sufficiently high to carry them clear of all surrounding habitations. To determine this height correctly requires a knowledge of the nature and qualities of the gases to be dealt with, the situation of the factory, size of boilers employed, if any, and other conditions that may be peculiar to the business to be carried on in the factory.

In order to assist the designer somewhat in making calculations for a

factory chimney, I have prepared the following table, which, so far as I am aware, is in its own way original. The first column gives the height of the chimney, which should never be less than 30 feet or more than 300, unless there are special reasons existing, similar to those which compelled the Scottish manufacturers to build their chimneys above the general line. Column 2 shows the amount of coal burned per hour per square foot of flue area at top of chimney, and is calculated by the following formula: $W\frac{A\sqrt{H}}{.07}$, in which W = weight of coal burned per hour as above; A = area of chimney in square feet; H = height of chimney in feet, and .07 = a constant.

Column 3 shows the height in inches of a column of water balanced by the draught pressure. Column 4 is calculated by the formula *H. P.* $=\frac{A\sqrt{H}}{.75}$.

Column 5..... $A=\frac{.8}{\sqrt{H}}$.

Column 6 ..... $A=\frac{.5}{\sqrt{H}}$.

Column 7..... $A=\frac{.1}{\sqrt{H}}$.

In all of which A denotes the area of flue in square feet and H represents the height of chimney in feet. By means of this formula the proper proportions of flues and chimneys for ordinary factory purposes may easily be ascertained.

Col. 1.	Col. 2.	Col. 3.	Col. 4.	Col. 5.	Col. 6.	Col. 7.
Height of Chimney in Feet.	Pounds of Coal Burned per Sq. Ft. Area of Top of Chimney.	Height in Inches of Column of Water Balanced by Draught Pressure.	Horse Power of Each Sq. Ft. of Chimney, Assuming 7 lbs. of Coal for Each Horse Power.	Area of Top of Chimney in Feet per Horse Power for One or Two Boilers.	Area of Top of Chimney in Feet per Horse Power for Several Boilers.	Area of Flue in Feet per Horse Power.
30	78.24	.218	7.3	.146	.91	.182
40	90.35	.296	8.4	.126	.077	.155
50	101.01	.364	9.4	.113	.070	.140
60	101.65	.437	10.3	.103	.064	.129
70	119.52	.5	11.2	.095	.059	.119
80	127.77	.58	11.9	.089	.055	.111
90	135.52	.636	12.6	.084	.052	.105
100	142.85	.729	13.3	.08	.05	.100
125	159.71	.911	14.9	.071	.044	.089
150	174.96	1.09	16.3	.065	.040	.082
175	188.98	1.26	17.6	.060	.038	.075
200	202.03	1.45	18.8	.056	.035	.07
225	214.28	1.64	20.	.053	.033	.066
250	225.87	1.82	21.	.05	.031	.063
275	236.90	1.99	22.	.048	.03	.06
300	247.43	2.18	23.	.046	.028	.057

A close adherence to the foregoing will, in every case, insure the most satisfactory results.

Usually factory chimneys are built so that there is an air space all round the central portion, being made circular in form, and for about one-sixth part of its length, from the foundation up, being laid with firebrick. This air space is not absolutely necessary unless where a strong flame—as when wood or shavings from a planing mill is used for fuel—would be constantly striking, then the air space prevents burning and cracking of the exterior walls.

The foundations of chimneys should be deep enough to take in all the footings some feet below the reach of frost, and each layer, of course, of stone used in footings and foundations should project beyond the layer above it not more than two-thirds of its thickness, thus increasing its area until a projection of foundation is obtained beyond the line of the base of the shaft equal to one-quarter of the height of the chimney above the ground surface. This is necessary to secure the stability of a tall shaft, even when the ground is good and solid, and when the soil is soft and unreliable the area for the foundation must be increased to suit the conditions, and here is where the good judgment of the architect or engineer comes in, for if he knows his business he will so increase and tie his foundation that settlement will not affect his superstructure in the slightest degree.

In setting out a chimney in brickwork, it is best to start with the top course and figure downward, as then provision can be made for every emergency that may arise. If the width of the flue is less than 5 feet, the walls of the chimney will only require to be of one brick for 25 feet below the coping, and if the outside of the shaft has a batter of ½ of an inch to the foot, the thickness of the walls at the base will determine itself.

Under no circumstances contract the area of a chimney at the outlet. It is better to have the flue some larger at the top than at the base, as the air and smoke are colder than below and move upward with less speed, so require more room to keep the flue from being crowded.

The best material by all odds for a factory chimney is good, hard burned brick placed on a solid stone foundation, and experience has taught us that the most economical form, which combines the best results, is an octagon. The draught in a chimney of this kind is nearly as efficient as the draught in a circular flue, and the cost of building is very much less.

A few years ago a square chimney was erected in the city of Hamilton, Ont., for the Canadian Screw Company, in which the area is equal top and bottom. It is 100 feet high from the boiler house to the floor coping. The area of the flue is 2,116 inches, with smoothly lined sides. It carries the smoke from three 100-horse power boilers, two drying ovens and four annealing furnaces; there is also connected with it an 8-inch pipe from the city drains. This chimney, it is said, is giving satisfactory results.

To insure the good working of a factory chimney, no openings should be made in it anywhere between the main inlet and the cope. If it is necessary to connect any pipes to the chimney, they should be placed in the intake before it reaches the shaft; and above all things, avoid having waste or exhaust steam let into the flue, if you wish the work to last any length of time.

Long ago, in the early history of tall chimneys, it was noticed that considerable expansion took place if the brickwork was kept hot for a few consecutive days, and the fact was published over and over again; notwithstanding many builders will insist on connecting the chimney with the main building or the engine or boiler house. This should never be done, for the expansion that is sure to take place will certainly crack and destroy the connection or become injured itself. Some years ago a chimney was built in Newcastle-on-Tyne, England. It is 99 feet high, stands upon a solid concrete foundation, has a firebrick lining for 35 feet from the ground, with an air space of 3 inches between the firebrick and the wall of the shaft. The upper part of the chimney is constructed of hard stock bricks, and has a uniform diameter of 6 feet 2 inches externally, while internally the flue increased outwardly from 3 feet 11 inches to 4 feet 8 inches in diameter, making the top a funnel shape inside, and a sort of trumpet form on the outside, as the finishing, being circular like the shaft, and projecting to meet the conditions of the enlargement of the flue, gives to it this peculiar appearance.

About a year ago a casing of ornamental brickwork was erected around the chimney, but independent of it, so that the casing of the shaft forms one of four octagonal turrets surrounding an exhibition building. The proximity of this brick casing to the chimney shaft afforded special opportunities of observing from the top of it any movement that might take place during the heating and cooling of the stack. Fires were started on Monday morning and kept going until Saturday night, when they were again drawn out and the chimney left to cool until the next Monday. Marks made on the brickwork of the stack before the fires were started were lifted above the casing a trifle over 2 inches when the shaft was made hot by the smoke and gases within. Here was convincing evidence of a movement of considerable dimensions, and from it the following conclusion was arrived at: that it would be unsafe to attach any other building to the shaft that was not heated uniformly with it, as, from the measurements made, the expansion equaled 1 inch to every 25 feet of brickwork, or 4 inches to each 100 feet. This was considered enough displacement to prevent any building remaining permanently attached to a factory chimney.

It may not be out of place before closing the subject of chimneys to say a few words about their care, for chimneys, like all other parts of a building, do occasionally want some attention. In the older England sweeps were government officials and held their positions from the crown, and it was their duty to see that all chimneys—high or lowly—within their jurisdiction were kept in good order, not only clean of soot, but also safe; in fact the sweep was a sort of government fire inspector, and when he and his minions found a defect in a flue or fireplace that was likely to lead to a fire, he was supposed to report the same to the proper municipal officer, whose duty it was to get the matter set to rights, and the owner of the building was taxed with the cost. This was a clumsy system, yet it suited the times, and doubtless many of the fine old English mansions left to us from the days of the Henrys are due to this old time supervision. To-day the responsibility of looking after chimneys devolves on the owner, and often he is the worst person that could be employed for the purpose, as his apparent interests and many other things stand in the way of having his chimneys meddled with, and the result is often disastrous.

All chimneys should be inspected at least once a year; they should not be allowed to remain foul, or trouble may ensue when next a fire is put in. They should not be permitted to get choked with soot, for a double reason; first, a sooty chimney will not draw well, and is in danger of firing at any time; and second, a chimney full of or blackened with soot offers special inducements to lightning to strike it. This may not be generally known, but it is a fact that a sooty chimney is more likely to receive an electric discharge than one that is kept clean.

In dwellings the stack between the attic floor and roof should get special attention, as any movement in either house or chimney will affect that portion first.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Jan. 10, 1895.

The Distribution of Electricity.—The Gas Industry in 1894.—*A Proposed Experimental Gas Works.*

Matters connected with the distribution of electricity from central stations continue to attract a fair share of public attention. The local authorities, as custodians of the public roads and thoroughfares, are getting somewhat alarmed at the demands made upon the subsoil. Gas and water mains, with an occasional valve or siphon box, could be dealt with; but when they are asked to allow culverts and transformer chambers to be laid, they begin to wonder what the end is going to be. And really they have reason to do so. We talk of the congested public traffic in some of our chief thoroughfares, and zealously protest against hoardings or other obstructions that are likely to increase the inconvenience. But what with gas and water mains and services, telegraph and telephone lines, power supply, to say nothing of the bulky electric culverts and chambers, there is reason to fear a congestion of traffic underground; while every fresh line, of course, increases the frequency of the visits of those exploring and excavating parties, bent on repair or alteration, that are regarded with so much annoyance in our busy thoroughfares. No wonder, then, that a question has arisen as to the rights of electric supply companies to utilize the public subsoil for the location of transformer chambers. Existing electric acts allow the placing of street boxes, but the local authorities naturally object to this regulation being applied without limit as to the size of such boxes. They contend that the object in view, when the act was framed, was simply junction boxes and such like appurtenances, and object to the "box" being enlarged or expanded to include a "chamber" or receptacle for transforming apparatus. A Board of Trade inquiry was recently held in London in respect to this matter, and the claims of electric supply companies, also those of the London County Council as the local authority, were set forth by counsel and expert evidence. The electric companies contended that the roof of a transformer chamber was as safe a place for public traffic as solid ground; that no danger to the public would result, and, as to inconvenience or crowding, they were willing to consult the wishes of the local authorities. But the County Council argued that the powers to place distributing boxes did not include transformer receptacles, and asked for some opinion of Parliament with respect thereto; that such apparatus would be a source of danger and of inconvenience to the public, and that, if once allowed, some thousands would be put down, and a heavy burden would be entailed in the necessary supervision.

The public at large are the more inclined to look with some suspicion and alarm on the presence of electrical apparatus in the subsoil, and to object to take their daily promenade upon the top of transformer chambers and such like receptacles, in consequence of the occurrence of another "accident," similar to the one mentioned in my last letter, whereby about 30 yards of the pavement in a London street were broken up, raised a few feet, and some of the stones smashed to pieces, whilst two pedestrians were injured. Examination showed that a gas main and an electric culvert ran parallel to each other, at about 18 inches apart, beneath the scene of this artificial earthquake. But the gas main, fortunately, was not injured, and is found to be quite sound, and there is no evidence as to leakage of coal gas into the culvert. But a quantity of sewer gas was found therein and is blamed for the explosion. A great deal of trouble has been taken of late years with regard to this same sewer gas. It is regarded as unfit company for any respectable persons, and is kept out of our houses, or supposed to be kept out, regardless of expense. Its presence in the culvert seems to point to a new danger, as it is certainly within easy walking distance of sitting and sleeping rooms. Unless it can be kept out of such culverts, the hygienic and life prolonging properties ascribed to the light of the future must be largely discounted. It is notorious that some of our modern refinements introduce evils greater than those which they are supposed to cure. And if it turns out that in introducing the purer atmosphere into our houses, about which so much has been said but nothing proved, there is a risk of stale sewer gases insidiously following the electric wires, the new system of lighting must be placed in that category.

The year 1894 has, on the whole, been more favorable to the gas industry than those which immediately preceded it. After the exacting periods of coal and labor troubles, it has afforded a degree of tranquility that was badly needed. The reckless sacrifice of trade and of wages that characterized the coal trade during the closing months of 1893 was followed by a time of quietness and retrenchment, and this spirit was further intensified by slackness of trade in general, and by a run of very mild weather. Although it was generally reported that all stocks were cleaned out at the end of 1893, still they were fully replenished before the summer was upon us, and a time of slack work was the result. The consequence is that gas companies have found the coal factor to be a very different person to deal with in 1894 as compared with 1893. Some endeavors in the way of united action, in respect to forcing prices in connection with certain large gas contracts were made, but the "rings" were of a very temporary character. Their operations may perhaps have resulted in raising rates a little, in regard to one or two early contracts, but this is the very outside, for it was soon evident that there would be a brisk competition for gas companies' orders. So there has been no difficulty in regard to the supply of staple material. The general clearance of coke stocks, that was a natural consequence of the events above named, has enabled prices to be well maintained throughout the year, and will be of some permanent benefit. For many householders who believed themselves to be bound hand and foot to the coal factor have now discovered that coke is a very good substitute, and will be glad to become regular users at prices a little less than those of coal. Although it might be supposed that coke is a well-known article, a certain prejudice exists against it, and many people have never tried it at all. They have been told that it is dusty, or that it gives off carbonic oxide. A very decided advance in the direction of removing such prejudices has been made. Coke is now selling at firm prices, and the end of the present winter will see stocks well cleared out. The prices for tar have been moderate, but rather better than in the previous year, and sulphate has fluctuated considerably. Throughout the summer it was fetching good prices, and those who did not sell out too early in the season have had a satisfactory year's trading. The climatic conditions, especially the absence of prolonged severe cold, and the introduction of the incandescent burner, have not been favorable to increased sales of gas for lighting purposes, but on the other hand there has been steady and substantial progress in the direction of stoves, engines and technical appliances. Certain failures in financial circles, together with the scarcity of sound home investments, have largely increased the demand for gas shares and stocks, so that any established undertaking can raise new capital at 4 per cent. or even less. Some of the best class of gas securities are selling at prices that barely realize 3 per cent. on the investment. It has long been supposed that local authorities enjoyed a great advantage over joint stock companies in respect to powers for raising capital. That whereas the company must offer 5 or 6 per cent. dividend, the authorities could issue loans on the security of the rates at 3 to 4 per cent. But it is evident that a well established company stands as well in the eyes of financiers as a local authority. It has been very pertinently remarked that the advantage offered by the local authority in respect to security lies in the fact that it is not a trader, and that directly it turns to trading, that advantage ceases. The public are beginning to see that the risks connected with the manufacture and supply of gas are not affected by the status of the owners. Whether private or public company, or corporation gas works, there is no difference. Thus, one of the principal benefits, if not the only advantage connected with municipal control of gas works, is rapidly becoming a vanishing quantity. This tendency is likely to be more marked in the future, and it will not be long before well managed joint stock undertakings are able to raise money cheaper than municipalities. There are not wanting instances of the fact that (to paraphrase a well known saying) "local authorities rush in where companies fear to tread," and this sort of thing does not tend to raise them in the favor of the investing public. Endeavors are still being continued in the way of promoting electricity companies, but it cannot be said that the electric light has made any progress during the year. Certainly there is no instance of the progress or welfare of a gas undertaking being affected by its operations. In fact, things are rather tending the other way, as any increase in the use of electricity has been more than counterbalanced by the inroads of the incandescent gas light. Previous to Christmas, the weather had been

unusually mild. There were no fogs, no frost or snow. But with the New Year a change came. For nearly a fortnight we have experienced continued frost, with heavy falls of snow, and there is every prospect of this state of things continuing for some time. This means a harvest season both as regards sale of gas and coke, and will go to compensate for the prolonged mild weather. So there is every reason for hopefulness, as far as the immediate future of our industry is concerned.

A question has lately been mooted in the *Journal of Gas Lighting* as to the advisability of establishing an experimental gas works on a working scale, the cost of same to be defrayed by contributions from those interested in the results. It is obvious that there are a great many questions that can only be satisfactorily disposed of by careful experiments, conducted by some competent person, who is free from the incubus of having to make each operation a commercially successful affair, as it must not be forgotten that the immediate object of an ordinary gas engineer or manager is to earn dividends, rather than to advance the science or practice of gas engineering. Such an undertaking would be self-supporting to a large extent. Any attempt to work it as a paying concern would frustrate the objects in view, by reducing it to the level of an ordinary gas undertaking. But if analyses of oxide, lime and other materials were undertaken on fixed moderate terms, or by annual agreement, many of the smaller class of gas undertakings would be glad to avail themselves of its services. There is also the possibility of combining with it a sort of practical school or college for the training of gas engineers. Arrangements could be made with a neighboring gas company to take off any approved quality of gas at not less than cost, and other residuals could be disposed of in the usual way. So that, if energetically taken in hand, the idea could be realized in practice at a very moderate cost. A guarantee fund, spread over such a large number of subscribers as to render the individual liability of any one contributor an unimportant matter, would meet the case. I do not think that, under present circumstances, there is the slightest possibility of such an undertaking being formed. The only thing that will induce gas undertakings to concerted action of any kind is something in the way of an imminent danger to their business. But, nevertheless, the suggestion is a valuable one, as with increased competition there is the more need to work in the best possible manner, with a view of supplying an efficient and a cheap source of light and heat.

The Determination of Tar in Gas.

Dr. W. Leybold, of Frankfort-on-the-Main, has been giving close attention to this subject of late, his last notes on his researches having been communicated to the *Journal für Gasbeleuchtung*. Our contemporary, the London *Journal*, thus summarizes the Doctor's findings:

When there is pressure within the main gas may be roughly tested for tar by means of strips of coarse paper held close to a small cock from which the gas issues. The intensity of the stain produced in a definite time—say half a minute—affords a good indication, for comparative purposes, of the amount of tar in the gas. When this rough method is used for estimating the efficiency of a washer or tar extractor, it is essential that the cocks should all be of the same bore, and the tests carried out under precisely similar conditions. When the stains at the outlet of a scrubbing apparatus are deeper than ordinarily, irregular working is indicated; and the cause should at once be sought and a remedy applied.

For the exact determination of small amounts of tar in gas, the following method is used: About 35 cubic feet of gas are drawn or driven through two U-tubes containing small pieces of glass and some glass wool. The gas supply is obtained from a glass tube passing well into the main at a point removed from any bend or angle. To the short protruding end of this tube the U-tubes are connected by small pieces of flexible tubing. The outlet of the last tube is attached to the inlet of an experimental meter, the outlet of which is, if necessary, connected to an aspirating apparatus. The U-tubes are, prior to the experiment, charged with coarse fragments of glass and glass wool, the rougher material being put in the limb by which the gas enters. The tubes should be about 6 inches in height and ¼ inch diameter, and have glass stoppers. When charged, they are dried at a temperature of 100° C., allowed to cool with a current of air passing through them, and then weighed with the stoppers closed. The tubes and meter are then connected as already described, and from 35 to 40 cubic feet of gas passed through them at the rate of 2 to 2½ feet per hour. The tubes are then detached from the apparatus, and air at the ordinary temperature of a room is drawn through them for about 15 hours. They are afterwards cleaned externally and weighed. The difference between the weights of the tubes before and after the passage of the gas gives the weight of tar in the volume of gas passed through them. The corresponding weight of tar for 1,000 cubic feet of gas is then easily calculated. A little naphthaline and some ammonium carbonate are doubtless carried off with the moisture in the current of air. By this method there was found at the outlet of a Pelouze condenser 26 grains of tar per 1,000 cubic feet of gas, and at the outlet of a Drory washer 12 grains per 1,000 cubic feet; the conditions under which the two appliances were working being rather dissimilar.

The determination of large quantities of tar cannot be made in the manner above described. Where it is necessary to find the total amount of tar in crude or partially washed gas, the simplest method is to collect by the aid of siphon tubes the tar removed by the apparatus, from the point of observation onwards, during 24 or 48 hours, for which period the make of gas is known. The tar collected is left to settle, and after the liquor has been removed from its surface, it is weighed. The weight of tar per 1,000 cubic feet of gas is then calculated. The total amount of tar in crude gas is therefore found by collecting it from the condensers, tar extractors, etc., during a day or other convenient period for which the volume of gas passing through the apparatus is known, and weighing it. If the efficiency of a tar extractor or washer is in question, the quantity of tar in the exit gas is found by U-tubes as already described, and that removed by the apparatus found by direct weighing as here indicated. Both results are expressed in the same terms, and then one hundred times the amount of tar taken out by the apparatus, divided by the total amount of tar entering it, expresses the efficiency of the apparatus as a tar extractor in percentage of the tar in the gas.

The following example illustrates the application of the method: The efficiency was sought of a Pelouze condenser, constructed to pass 700,000 cubic feet of gas per day, in operation at the Frankfort gas works. It removed in 24 hours 420.2 lbs. of tar from 665,400 cubic feet of gas, or at the rate of 4420.5 grains per 1,000 feet. The gas passing out of the Pelouze condenser contained 15.5 grains of tar per 1,000 cubic feet. Therefore the total amount of tar per 1,000 cubic feet of gas entering the apparatus was $4,420.5 + 15.5 = 4,436$ grains, of which 4,420.5 grains were removed by it. The efficiency of the Pelouze condenser during the 24 hours was consequently—$(4,420.5 \times 100) \div 4,436 = 99.65$ per cent. A Drory tar washer at the Metz gas works had on a particular occasion an efficiency of 99.07 per cent., and a Pelouze condenser at Hanau, working before the exhauster, and with deficient condensing plant, showed an efficiency of 99.91 per cent.

The exhauster abstracts a very considerable quantity of tar from the gas, as may be experimentally demonstrated. In the estimation of the comparatively small amounts of tar in the gas passing from the washers, the U-tubes may be replaced by a straight tube with contracted ends. The tube contains a number of diaphragms with roughened surfaces, pierced with holes 0.1 inch in diameter; the holes in the different diaphragms being set out of line. The tar in the gas passing through the tube is deposited from it by the force of impact on the diaphragms, and is almost wholly caught in the first section of the tube. The tube is weighed before and after the passage of the gas through it, in the same manner as the U-tubes. If used where the external temperature is much below that of the gas, the tube should be protected from the cold by having a cloth wrapped round it, in order to avoid excessive deposition of moisture from the gas.

An Out-of-the-Way Coal Field.

Dr. K. A. Weithofer notes that the Carpano coal field (Austria), of which so little is known, is situated in Istria, on the promontory of Quarnero, in the Adriatic Sea, between Trieste and Fiume, 21 miles from the railway station of Pisino. It is near the northern extremity of the Gulf of Arsa, and is connected by a small narrow-gauge railway with the harbor of Valpidocchio. It is about four miles from the little seaport of Rabaz, and is the only coal mine now being worked in Istria. The coal measures form part of a geological basin or depression stretching from Trieste across Istria. The formation is of the older tertiary period, and rests upon hippurite limestone, of the upper cretaceous formation. The depression is filled with numulitic limestone, compact sandstone and argillaceous marl, below which is found a mixture of marine and coal bearing lacustrine sediments, called the Cosina beds, and forming part of the liburnian stage of the lower Eocene period. It is of special geological interest as showing the alternations of marine and fresh water formations, the sea having periodically advanced and retreated along the shores of the basin. The value of the coal is much diminished by the frequent occurrence of what is called "sootiness" in the seams. The coal loses its firmness and consistency, becomes friable,

and when dry resembles soot. It is usually wet, and then forms a kind of black grease. From the way the soot makes its appearance, it must be attributed to the oxidizing influence of the atmosphere. All the upper seams, even where they rest upon the limestone, have a belt of this oxidized coal toward the edge of the depression, and wherever clefts and fissures occur, produced by the water oozing in at the side of the strata. Even where the fissure is closed it is possible to trace its former presence in the seam, the sooty coal in two or three places being found in the midst of the coal seam. The proportion of water in this decomposed coal is 1.70, as against 1.46 per cent. in the coal, and of ash 14.96, as against 8.84 per cent. in the coal; the other chemical constituents diminishing in inverse ratio, especially the carbon and hydrogen.

The Arsa coal differs in several respects from ordinary lignite or brown coal. It is shiny, almost black, and has a slaty appearance in the limestone seams, and a seamy texture in the roof seams, with uneven fracture. When rubbed it emits a strong bituminous smell and burns with a bright flame and much smoke. Analyses have been made by Professor Schwackhofer as follows: Carbon, 60.94; nitrogen, 1.28; hydrogen, 4.08; water, 2.01; oxygen, 17.54; ash, 14.15. When mixed with potash or carbonate of soda the Carpano coal, even after being heated to the boiling point several times, still retains a pale brown color. Treated with a solution of bichromate of potash and sulphuric acid for 14 days and prolonged heating, it yielded black coal dust, burning with a flame line ordinary coal. Brown coal with this solution usually loses its color after a few hours and has no combustible residuum, while black coal, after dissolving for several months in chromic acid, retains its black, combustible character. The best result was obtained with chlorate of potash, nitric acid and ammonia. In this and other respects the most striking characteristic of the Carpano coal is its resemblance to pure black (hard) coal. It has a great tendency to cake, and yields about 55 to 60 per cent. of coke, which has been utilized in a furnace in the neighborhood. For blast furnaces, however, the percentage of sulphur and ash is too high to make it available. The mine is worked by galleries 19 to 26 feet broad, leaving pillars from 60 to 100 feet square. There is a factory at the old harbor of Stallie for utilizing the dust coal in the manufacture of briquettes. These are made in presses with vertical rollers, pitch being used to bind the brick. About 17,000 tons were manufactured in 1891 and sent to Dalmatia, Trieste, Fiume and Italy. The number of miners in 1891 was 1,169, and the total coal production was 81,028 tons, for which a ready market was found in Istria, Dalmatia and Italy.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. WALTER WHITMAN has resigned from the service of the Keene (N. H.) Gas and Electric Light Company.

THE proprietors of the Waterbury (Conn.) Gas Light Company have applied to the authorities for permission to increase the capital stock to $390,000, from $250,000.

"ISAG," writing from Dallas, Texas, under date of the 16th inst., says: "Last night the City Council granted a franchise to L. S. Berg, C. D. Wakefield and others to erect an electric light plant in this city. It has been rather the belief that this franchise was asked for to serve the purpose of a whip over the Dallas Electric Company, a child of the Fort Wayne Company. This belief is probably founded on the fact that grantees of this franchise are operating an electric car line here, the power for which is rented from the Dallas Electric Company. It is, however, understood that the owner of large interests in an electric plant in another large city of Texas is concerned in this move, and it is somewhat coincidental that he has been greatly annoyed by the Fort Wayne Company in the other city. It will be interesting to watch the outcome, for the affair reminds one of the old saying: 'When —— fall out,' etc."

AT the annual meeting of the shareholders of the Cleveland (O.) Gas Light and Coke Company the Directors chosen were: D. Sinton, J. H. Morley, E. P. Eells, W. J. Hayes, F. A. Sterling, M. S. Greenough and C. H. Beardslee. At the organization meeting of the Board the officers named were: President, M. S. Greenough; Vice-President, J. H. Morley; Secretary and Treasurer, C. H. Beardslee. Mr. Morley refused a re-election to the Presidency, his declination being based on his desire to be relieved from the onerous duties attaching to the office. The Directors passed the following resolutions respecting their ex-President:

Resolved, That this Board desires to place on record its high appreciation of the faithful and efficient services which Mr. J. H. Morley, retiring President of this Company, has rendered during the long term of his connection with it. For more than 40 years he has been actively concerned in its management, and for 12 years has been its President; and it is safe to say that the success of the Company is in a large measure due to the sagacious and judicious energy which he has shown in shaping the policy of the Company and in solving the difficult problems which have arisen in its history.

Resolved, That in view of the declaration of Mr. Morley to decline a re-election to the Presidency, this Board tenders its most cordial thanks to him for his able and faithful devotion to its interests during his long connection with it."

AT the annual meeting of the Pulaski Gas Light Company, of Little Rock, Ark., a semi-annual dividend of 3 per cent. was declared, payable on demand; and the following executive management was elected: Directors, C. F. Penzel, J. A. Fones, C. M. Taylor, R. A. Little, Philip Pfeifer, John G. Fletcher and S. M. Apperson; President, James A. Fones; Treasurer, Oscar Davis; Secretary and Superintendent, J. T. Pullen.

THE Cook-Stoddard Manufacturing Company, of Dayton, Ohio, has been incorporated, with a capital of $30,000, by Messrs. J. H. Stoddard, Hugo Cook, Chas. Craighead and Wm. Kinnard. The concern proposes to manufacture and put on the market a gas engine constructed on the lines of the patent issued to Mr. Hugo Cook, who was formerly Superintendent of the National Cash Register Company.

IN the Superior Court, Fall River, Mass., a jury failed to agree in the case of Pineau vs. the Fall River Gas Works Company. Plaintiff sued for damages on account of illness occasioned by the inhalation of illuminating gas that entered his house because of a break in the Company's street main.

MR. WM. B. MILLER, who, as receiver thereof, has been operating the plant of the Cartersville (Ga.) Gas Company, informs us that the same was recently sold by him per order of the Court, the purchaser being a corporation known as the Cartersville Light and Power Company. The price paid was $7,501. The election of officers for the ensuing year will take place this week.

ASSEMBLYMAN CLARK has introduced a bill to the New York Legislature which proposes to give to gas and electric light companies the right to acquire property by means of condemnation proceedings.

AT the annual meeting of the Columbia (Pa.) Gas Company the regular semi-annual dividend was declared, and a resolution was adopted fixing the rate for gas used for fuel and power purposes at $1.40 per 1,000 cubic feet. The officers elected were: Directors, H. M. North, H. F. Brewer, W. B. Given, M. S. Shuman, Jacob Pfahler and M. A. Cowden; President, James A. Meyers; Secretary and Treasurer, Joseph Janson; Superintendent, Robert Beacham.

THE new power house for the Hartford (Conn.) Street Railroad Company is now completed; and it is said to be one of the finest, if not the finest, in the New England States. It is 66 feet wide and 230 feet long, and is entirely firepoof, no woodwork at all having been used in the construction. It was designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., and is covered by that firm's patent anti-condensation corrugated iron roofing.

THE Board of Gas and Electric Light Commissioners, of Massachusetts, through its Chairman, Mr. Forrest E. Barker, has made the following report respecting the petition of the Brookline (Mass.) Gas Light Company to increase its capital stock in the sum of $1,000,000: "This was an application by the Brookline Gas Light Company for the approval by this Board of the issue of 10,000 shares of new capital stock of the par value of $1,000,000. The petition is brought pursuant to Chapter 518 of the Acts of 1894. The vote of the corporation declares that the new stock is to be used for the purpose of increasing the plant and paying off the debts of the Company. Upon this petition numerous public hearings have been given, at which minority interests were represented in opposition. Since the last issue of stock and bonds of this Company extensive additions have been made to its plant for both manufacture and distribution. It appeared at the hearing that the outstanding notes, on Sept. 1, 1894, somewhat exceeded $1,000,000, and this amount had since been largely increased. The construction of new plant has also gone forward during the progress of the hearing. After a careful scrutiny of the Company's accounts to January 1, 1895, and an examination of its plant as it now exists, the Board is satisfied that the amount

of stock approved in the following vote does not exceed the fair cost of the extensions made in addition to those paid from existing stocks and bonds; and, further, that when such stock shall issue, the entire stock and bonds outstanding will not exceed the fair structural value of the Company's plant. The effort of the Board has not been merely to ascertain the amount actually expended upon the plant, but rather how much of that expenditure might fairly be represented in the new capital stock. The following is, therefore, adopted by the Board:

"On the application of the Brookline Gas Light Company for the approval of an issue of new stock to the amount of $1,000,000 for the object named in said application and vote after public notice and hearing and an examination of the assets and liabilities of the Company, it appearing that said stock has been duly authorized, and that said Company has complied with the laws, and that new stock to the amount hereinafter named is reasonably requisite for the purpose for which such issue has been authorized.

"*Ordered*, That the Board hereby approves of the issue of 10,000 shares of new capital stock of the par value of $100 each, in conformity with all the requirements of the law relating thereto, the proceeds of said stock to be applied to the payment and cancellation of the indebtedness incurred for additions to and improvements of said Company's plant, and for no other purpose.

"For the purpose of determining the price or rate at which said shares shall be offered proportionately to the stockholders, it is ordered and determined by the Board, taking into account previous sales and other pertinent conditions, that the market value thereof for the purpose aforesaid shall be fixed at $100 per share."

AT the annual meeting of the Brooklyn (N. Y.) Gas Light Company the Directors chosen were: L. W. Stockwell, H. K. Sheldon, W. J. Logan, Geo. H. Prentiss, Thos. E. Stillman, E. R. Chapman, A. E. Orr, Felix Campbell and G. F. Gregory. From this it will be seen that the members of the prior Board who failed of re-election were: C. W. Blodget, E. H. R. Lyman, H. D. Polhemus and W. A. Pettit.

A BOSTON correspondent, writing under date of the 21st inst., says:

To the Editor AMERICAN GAS LIGHT JOURNAL: It may be of interest to your readers to learn of an example of energetic work, just completed by the contractors, Messrs. Bartlett, Hayward & Co., of Baltimore, Md., in the extension of the works of the Brookline Gas Light Company, at Allston, Mass. The order for the work was given in the latter part of last summer, and included the construction of a purifying house, 118 feet long by 40 feet wide, and two stories high, which shelters four purifying boxes, 28 feet by 21 feet by 5 feet deep, a Berlin center valve and connections to the boxes, and a complete plant for automatically handling the oxide by means of conveyers. In the generator house was placed a twin generator of the improved Jerzmanowski type, of 1,000,000 cubic feet capacity, and a battery of two 200-horse power Heine boilers, with Hawley down-draught furnaces; and in the retort house were placed two through fixing benches of 6's with regenerator furnaces. In the condenser house was placed a multitubular condenser of over 2,000,000 cubic feet capacity; in the meter house a hydrogen meter 11 feet in diameter, and a station meter 12 feet in diameter; and in the holder yard a storage holder of 1,500,000 cubic feet capacity. The holder rests in a steel tank, the dimensions of which are 142 feet in diameter by 32 feet 6 inches deep. Operations were commenced at the works on October 1st on all portions of the construction, except in the instance of the gasholder tank, which could not be commenced until a week later, owing to the non-completion of the foundations for receiving the same. From this time on the work was pushed rapidly, the various sections being completed from the date named until the first of the present year, when it was all completed; a period of only three months being taken up in finishing this big undertaking.

AT the annual meeting of the Brooklyn (N. Y.) Firebrick Works Company a semi-annual dividend of 3 per cent. was declared, and the following officers were chosen: Directors, E. D. White, Wm. Beard, D. H. Valentine, Fred. T. Aldridge, S. L. Keeney and Daniel Creem; President, A. H. Gutkes; Vice-President, E. D. White; Secretary, Fred. P. Morgan.

ON the 18th inst. Mr. Daugherty, of Peoria, introduced a bill in the Illinois Assembly which provides that in all cities of the State, where gas or electric light plants have been or may hereafter be established the authorities may contract for gas or electricity for the city and the inhabitants for a period not exceeding 30 years. In all cities where plants are now in operation the authorities may purchase or lease such gas and electric light plants from the owner or owners of the same. Provided, that before such lease or purchase shall be binding the question shall first have been submitted to the people at a general election and a majority of them have voted in favor of it, the ballot specifying the yearly rental, if a lease, or the consideration price, if a purchase, on the ballot. Having been once defeated the question cannot again be submitted within 10 months. Such city may borrow money and levy and collect a general tax in the same manner as other municipal taxes are levied and collected for the purchase, leasing or maintenance of such gas or electric light works and appropriate money for the same.

MR. O. O. THWING, formerly with the Laclede Gas Company, of St. Louis, has succeeded Mr. Mr. A. B. Beadle as Superintendent of the manufacturing department of the Milwaukee Gas Light Company.

THE officers chosen by the Newport (R. I.) Gas Light Company at the annual meeting were: Directors, Henry Bull, James C. Swan, Philip Rider, T. A. Lawton, Melville Bull and Andrew K. Quinn; President, Henry Bull; Secretary, T. A. Lawton; Treasurer, A. K. Quinn.

THE annual meeting of the San Francisco (Cal.) Gas Light Company was held on the 15th inst. There was the usual attendance and the usual large number of proxies. The reports of the President and Secretary were read and placed on file. From them it was learned that the business has been conducted on about the same scale as in recent previous years. There was no contest for supremacy in the election, and the old Board of Directors was returned unanimously. The Directors are: Adam Grant, Jos. B. Crockett, Levi Strauss, Geo. W. Prescott, Daniel T. Murphy, A. H. Payson and J. Downey Harver; President and Engineer, J. B. Crockett; Secretary, W. G. Barrett. During the year dividends amounting to 3.65 per cent. on the stock were paid.

THE Springfield (Mass.) Gas Company is canvassing West Springfield with a view to determining whether the piping of that town for gas supply would be profitable. The franchise granted a year or so ago, to Geo. Olney and his associates, for a separate Company for West Springfield has lapsed.

THE latest thing from the Alexandria (Va.) municipal gas works is an account of an explosion there, which caused damages amounting to perhaps $400. We judge that the explosion was in the condensing apparatus; for that is about the way we translate the account forwarded by our informant: "From what could be learned as to the cause, it appears that the workmen attempted to remove the cap from one of the large mains, which was filled with water for filtering purposes. In doing so the engine room became filled with gas, which exploded, setting fire to the roof."

AT the annual meeting of the Pawtucket (R. I.) Gas Company, Mr. William McGregor's appointment as General Manager and Superintendent, to succeed the late Mr. S. G. Stiness, was formally ratified.

AT the annual meeting of the Equitable Natural Gas Company, of Pittsburgh, Pa., the report of the President (Mr. Robert B. Brown) contained the following: "When the Equitable Gas Company was organized it was intended to supply mills and factories. This has been the fact until one year ago, when the Board of Directors, recognizing that the cost of procuring natural gas was increasing yearly, concluded to work gradually into the low pressure business of supplying dwellings. The question of expending so large a sum to pipe the several districts of the city was carefully discussed, and the conclusion arrived at was to procure all the information obtainable for the manufacturing of fuel gas and then pipe the streets in such manner that should natural gas become too costly the plant could be utilized for manufactured fuel gas. The Directory of the Equitable Company, being largely interested in the manufacture of illuminating gas, the Company has been enabled to keep informed as to the progress made in the manufacture of fuel gas. Mr. Faux, Engineer of the South Side Illuminating Gas Company, writes: 'The manufacture of a satisfactory fuel gas is possible. As I am informed, the plan or system your Company is now pursuing seems, in my judgment, the proper one.' In accordance with the adopted plan of thoroughly piping the streets of the several districts with large diameter, strong, cast iron pipe, with all large openings for connections that will not interfere with a good supply of gas, all pipe to be carefully laid and all the drips to be placed in the proper places. Pipes so laid can be utilized for either natural gas or manufactured gas. The streets of East Liberty and Shadyside districts have been piped to conform to this system, and as soon as the weather will permit the Oakland, Homewood and Highland districts will be piped."

AT the annual meeting of the Newburyport (Mass.) Gas and Electric Company a semi-annual dividend of 5 per cent. was declared and the following officers were chosen: Directors, Eben F. Stone, W. H. Swasey, L. B. Cushing, T. C. Simpson, W. R. Johnson and Samuel Marsh; President, E. F. Stone; Treasurer and Clerk, D. D. Tilton.

THE Directors for the ensuing year in the Hackensack (N. J.) Gas Company are: G. W. Conklin, F. B. Poor, Wallace Dunbar, C. E. Lydecker, C. Zabriskie, D. W. Chamberlain and E. A. Pearce.

THE Consolidated Gas Company, of Baltimore, Md., has placed an issue of $893,000 of 5 per cent. bonds, to replace an equal amount of a loan known as Equitable 6's.

The Market for Gas Securities.

Consolidated sold off during the week, 110 shares having changed hands yesterday (Thursday) at 128¼, and the opening to-day was made at 127½ bid, offered at 129½. The tendency is to lower prices, and the flood of bills at Albany ordering marked cuts in gas rates in cities of the first class is responsible for the weak feeling. It is too early yet to attempt to predict what the outcome is to be, but the writer, in the course of a conversation had with a man well known in legislative circles, was told that it is almost a certainty that a bill cutting the rate in New York and Brooklyn to $1 per 1,000 will in due time reach the Governor's chamber. Our informant rang the changes quite heavily on the fact that the Brooklyn Companies showed conclusively last year that gas could be made and sold at a profit at even less than $1.

Another feature of the week was the slump in New York and East River common, which is offered at 27. We still insist that the stock is cheap at anything under 30. The Brooklyn situation is unchanged, save that the matters underlying amalgamation are going on smoothly. Chicago gas is wavering and uncertain, but holders need not concern themselves about the failure to carry out the annual meeting routine. At the proper time an organization will be perfected that will in every sense be preferable to the one now existing. Bay State gas is weak, and Baltimore Consolidated about holds its own.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

January 28.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	127½	129½
Central	500,000	50	115	—
" Scrip	220,000	—	100	--
Equitable	4,000,000	100	181	183
" Bonds	1,000,000	—	107	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	154	157
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	95	—
" Bonds	150,000	—	95	—
N. Y. & East River Gas				
Common	5,000,000	100	25	27
Preferred	2,000,000		44	47
Bonds	3,500,000	100	84½	85½
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	40	42
Preferred	5,000,000	100	90	91½
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	118	122
Citizens	1,200,000	20	60	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	170	175
" Bonds	300,000		103	—
Peoples	1,000,000	10	85	—
" Bonds (7's)	368,000	—	100	—
(6's)	94,000	—	98	100
Metropolitan	870,000	100	160	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	200	—
" Otfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	190	200
" Bonds	1,000,000	—	107	110

Advertisers Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	140
Wm. Henry White, New York City	139
Fred. Bredel, Milwaukee, Wis	135
H. C. Slaney, Brooklyn, N. Y	139
Geo. R. Rowland, New York City	139
Joseph P. Gill, New York City	139
The Western Gas Construction Co., Fort Wayne, Ind	130
Humphreys & Glasgow, New York City	126
T. G. Lansden, St. Louis, Mo	123
David Leavitt Hough, New York City	123

CHEMISTS.

Durand Woodman, New York City	126

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md	137
United Gas Improvement Co., Phila., Pa	129
Burdett Loomis, Hartford, Conn	140
National Gas and Water Co., Chicago, Ills	131
Economical Gas Apparatus Construct'n Co., Toronto, Ont	143
The Western Gas Construction Co., Fort Wayne, Ind	130

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	140
Continental Iron Works, Brooklyn, N. Y	138
Deily & Fowler, Phila., Pa	140
Kerr Murray Mfg. Co., Fort Wayne, Ind	136
Stacey Mfg. Co., Cincinnati, Ohio	139
Bartlett, Hayward & Co., Baltimore, Md	137
Davis and Farnum Mfg. Co., Waltham, Mass	136
R. D. Wood & Co., Phila., Pa	138
Isbell-Porter Company, New York City	138
Fred. Bredel, Milwaukee, Wis	135
United Gas Improvement Co., Phila., Pa	139
Berlin Iron Bridge Co., East Berlin, Conn	126
National Gas and Water Co., Chicago, Ills	131
Economical Gas Apparatus Construct'n Co., Toronto, Ont	143
The Western Gas Construction Co., Fort Wayne, Ind	130
Humphreys & Glasgow, New York City	126

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	139
R. D. Wood & Co., Phila., Pa	138
James R. Floyd & Sons, New York City	140
Continental Iron Works, Brooklyn, N. Y	138

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md	137
Fred. Bredel, Milwaukee, Wis	135
J. H. Gautier & Co., Jersey City, N. J	135
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	134
Adam Weber, New York City	134

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	139

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich	123
G. Shepard Page's Sons, New York City	139

GAS METERS.

John J. Griffin & Co., Phila., Pa	144
American Meter Co., New York and Philadelphia	143
The Goodwin Meter Co., Phila., Pa	142
Helme & McIlhenny, Phila., Pa	143
D. McDonald & Co., Albany, N.Y	143
Nathaniel Tufts, Boston, Mass	142
Maryland Meter and Mfg. Co., Baltimore, Md	142
Harris Bros. & Co., Phila., Pa	142
Metric Metal Co., Erie, Pa	141

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	141
M. J. Drummond, New York City	141
R. D. Wood & Co., Phila., Pa	138
Warren Foundry and Machine Co., New York City	141
Donaldson Iron Co., Emaus, Pa	141
Addyston Pipe and Steel Co., Cincinnati, O	123
John Fox, New York City	141

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City	135

GAS COALS.

Penn Gas Coal Co., Phila., Pa	133
Perkins & Co., New York City	132
Despard Gas Coal Co., Baltimore, Md	133
Westmoreland Coal Co., Phila., Pa	133

CANNEL COALS.

Perkins & Co., New York City	132
Log Mountain Coal, Coke and Timber Co., Pineville, Ky	133

GAS-ENRICHERS.

Standard Oil Co., New York City	133
The Sun Oil Co., Pittsburgh, Pa	133
W. H. Townsend, New York City	133

COKE CRUSHER.

C. M. Keller, Columbus, Ind	133

AIR COMPRESSORS.

Clayton Air Compressor Works, New York City	124

COAL TAR PUMPS.

Clayton Air Compressor Works, New York City	188

GAS GAUGES.

The Bristol Co., Waterbury, Conn	135

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City	131
Wilbraham Baker Blower Co., Phila., Pa	131
Isbell-Porter Co., New York City	138

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City	138
Continental Iron Works, Brooklyn, N. Y	138
G. Shepard Page's Sons, New York City	139

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J	134
B. Kreischer & Sons, New York City	134
Adam Weber, New York City	134
Laclede Firebrick Mfg. Co., St. Louis, Mo	134
Cyrus Borgner, Phila., Pa	134
James Gardner, Jr., Pittsburgh, Pa	134
Henry Maurer & Son, New York City	134
Baltimore Retort and Firebrick Co., Baltimore, Md	134
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	134
Brooklyn Firebrick Works, Brooklyn, N. Y	134
F. Behrend, New York City	124

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N. Y	134
F. Behrend, New York City	124

INCANDESCENT GAS LAMPS.

Welsbach Light Co., Gloucester, N. J	125

BURNERS.

C. A. Gefrorer, Phila., Pa	126
Moses G. Wilder, Phila., Pa	123

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn	123

STREET LAMPS.

J. G. Miner, Morrisania, New York City	135
Bartlett Street Lamp Mfg. Co., New York City	135

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City	131
Greenpoint Chemical Works, Brooklyn, N. Y	131
Henry W. Douglas, Ann Arbor, Mich	131
Read, Holliday & Sons, Ltd., New York City	134

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind	128
Isbell-Porter Company, New York City	138
Wilbraham Baker Blower Co., Philadelphia, Pa	131
Connelly Iron Sponge and Governor Co., New York City	131

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y	130
Chapman Valve Manufacturing Co., Boston, Mass	130
R. D. Wood & Co., Phila., Pa	138
Continental Iron Works, Brooklyn, N. Y	138
John Fox, New York City	141
The P. H. & F. M. Roots Co., Connersville, Ind	128
Isbell-Porter Co., New York City	138
The Western Gas Construction Co., Fort Wayne, Ind	130

ELECTRICAL APPARATUS.

Wm. Henry White, New York City	139

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa	108

ENGINES AND BOILERS.

The Hazelton Boiler Co., New York City	124

PURIFIER SCREENS.

John Cabot, New York City	135

GAS STOVES.

American Meter Co., New York and Philadelphia	127
The Goodwin Meter Co., Phila., Pa	142
George M. Clark & Co., Chicago, Ills	125
Maryland Meter and Manufacturing Co., Baltimore, Md	142
The Schneider & Trenkamp Co., Cleveland, O	124

CHINA GAS KILNS.

F. A. Wilke, Richmond, Ind	123

GAS FLOW COMPUTERS.

Wm. Cox, Stapleton, N. Y	140

COIN WRAPPERS.

Alvord & Co., Detroit, Mich	15

PATENTS.

H. B. Willson & Co., Washington, D. C	126

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass	130
New York Marine Paint Co., Poughkeepsie, N.Y	130

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y	135

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md	137
Continental Iron Works, Brooklyn, N. Y	138
Deily & Fowler, Philadelphia, Pa	140
Davis & Farnum Mfg. Co., Waltham, Mass	136
Kerr Murray Mfg. Co., Fort Wayne, Ind	136
Stacey Mfg. Co., Cincinnati, Ohio	139
R. D. Wood & Co., Philadelphia, Pa	138

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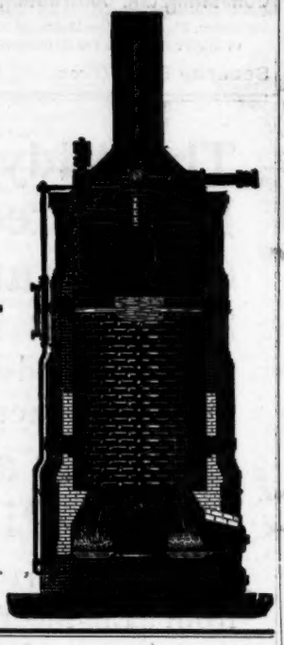

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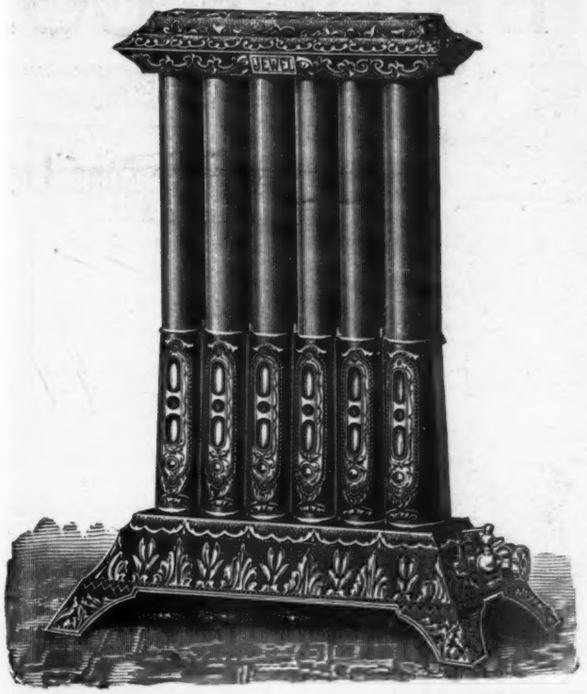

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If these Radiators were simply a duplication of what has been done, they would be worth but a passing notice.

One Continuous Tube
Instead of a Single Tube Construction.
This gives greater burner capacity.

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Dear Sir—Owing to the severe storm of Wednesday night, which did so much damage to telegraph, telephone and electric light property in the City, I considered it would be well to examine the Welsbach lights in Rittenhouse Square. I therefore sent a man to make a critical examination of the lights, after they had been lighted the following night. It gives me great pleasure to state that of the 48 lights in the Square, not one was out of order or required repairing, all of them being in perfect condition, and showing no sign of being affected by the storm.

Very truly yours,

R. J. ROLSTON, Superintendent.

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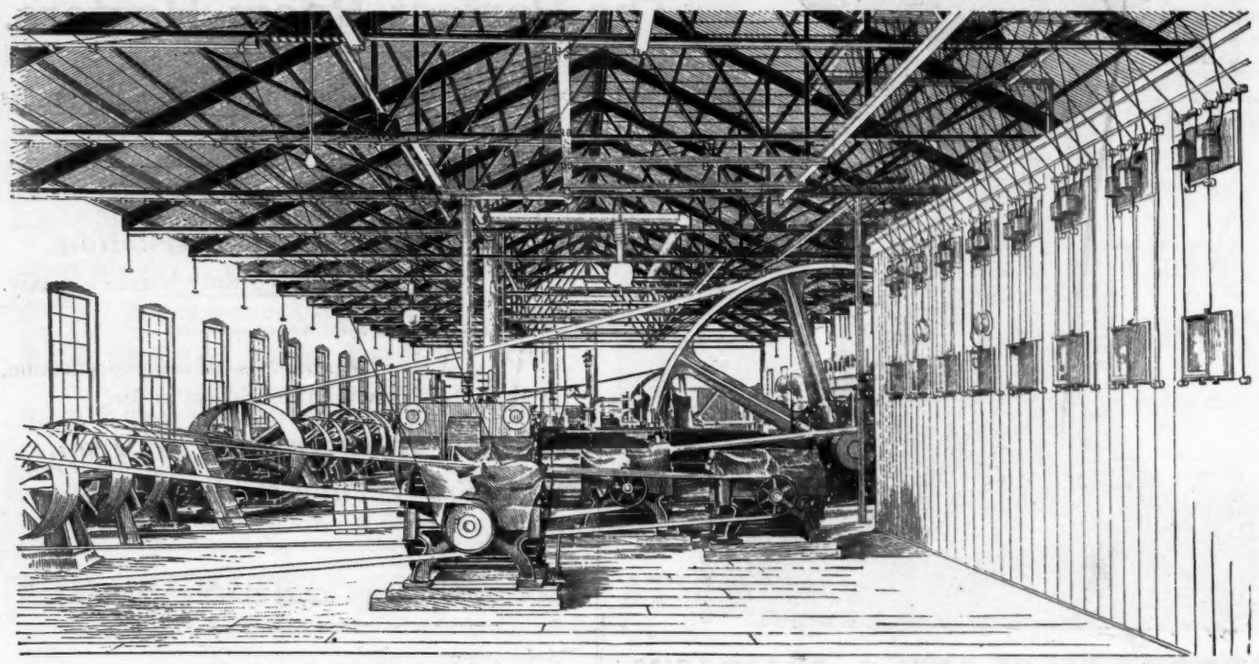

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Connecticut Electric Company, at Waterbury, Conn. The building is 51 feet in width by 251 feet in length, with brick walls and iron truss roof covered with corrugated iron. For an Electric Light Station, where the risk from fire is very great, this construction particularly commends itself, as this risk is entirely eliminated.

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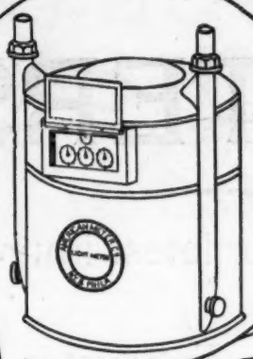

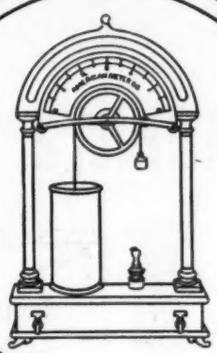

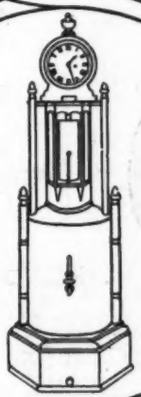

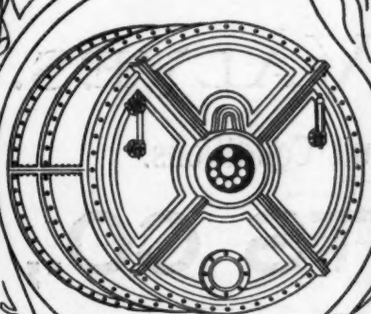

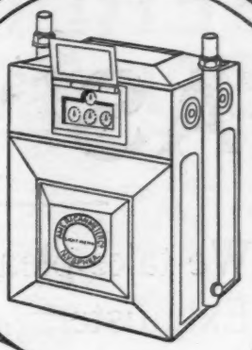

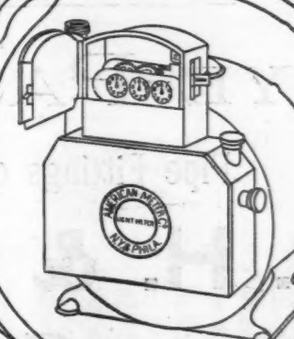

PUBLIC LIGHTING TABLE.

FEBRUARY, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Fri.	1	11.10 PM	6.10 AM	5.05	6.15
Sat.	2	12.20 AM FQ	6.10	5.05	6.15
Sun.	3	1.30	6.00	5.05	6.15
Mon.	4	2.40	6.00	5.05	6.15
Tue.	5	3.50	6.00	5.10	6.10
Wed.	6	4.50	6.00	5.10	6.10
Thu.	7	5.30	6.00	5.10	6.10
Fri.	8	No L.	No L.	5.10	6.10
Sat.	9	No L. PM	No L.	5.10	6.10
Sun.	10	No L.	No L.	5.10	6.10
Mon.	11	6.00 PM	9.10 PM	5.10	6.10
Tue.	12	6.00	10.20	5.20	5 55
Wed	13	6.00	11.40	5.20	5.55
Thu.	14	6.00	12.50 AM	5.20	5.55
Fri.	15	6.00	2.00	5.20	5.55
Sat.	16	6.00 LQ	3.10	5.20	5.55
Sun.	17	6.10	4.10	5.20	5.55
Mon.	18	6.10	5.00	5.20	5.55
Tue.	19	6.10	5.40	5.30	5.55
Wed	20	6.10	5.40	5.30	5.55
Thu.	21	6.10	5.40	5.30	5.55
Fri.	22	6.10	5.40	5.30	5.55
Sat.	23	6.10	5.40	5.30	5.55
Sun.	24	6.20 NM	5.40	5.30	5.55
Mon.	25	6.20	5.40	5.30	5.55
Tue.	26	6.20	5.40	5.30	5.45
Wed.	27	6.20	5.40	5.30	5.45
Thu.	28	6.20	5.40	5.30	5.45

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr	2161.20	Total, yr	3987.45

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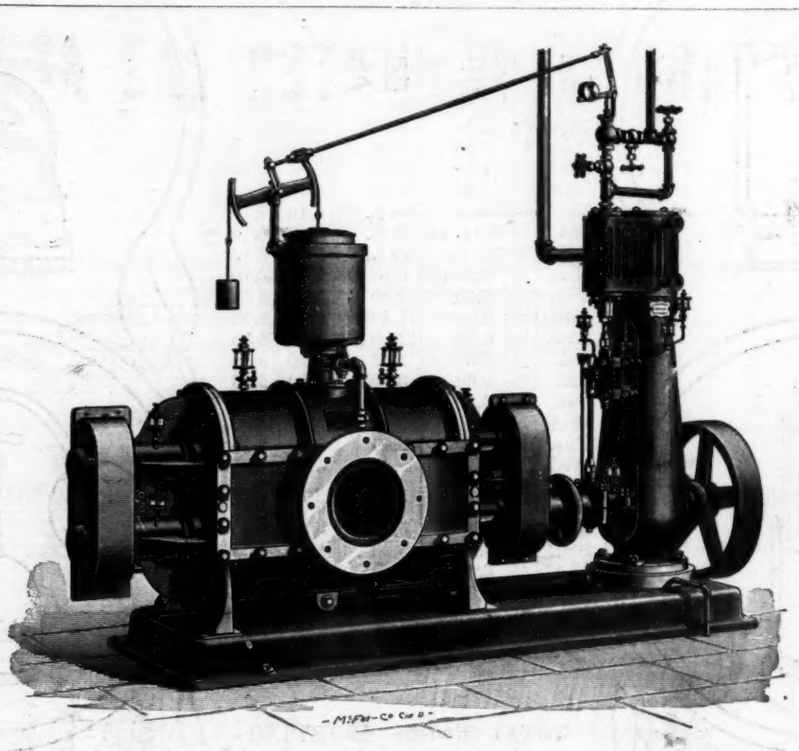
We take pleasure in illustrating herewith our latest improved Gas Exhauster.

It is without question the most perfect Exhauster ever constructed.

Our Latest Improved **Automatic Gas Governor** and **Steam Bye-Pass Valve** are the best in the market.



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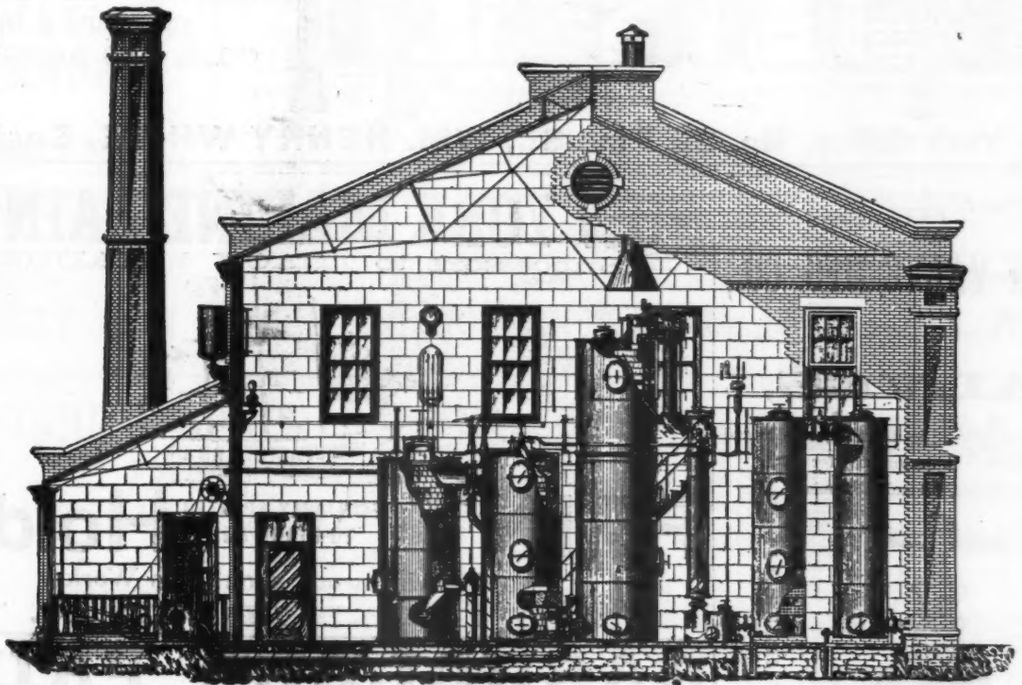

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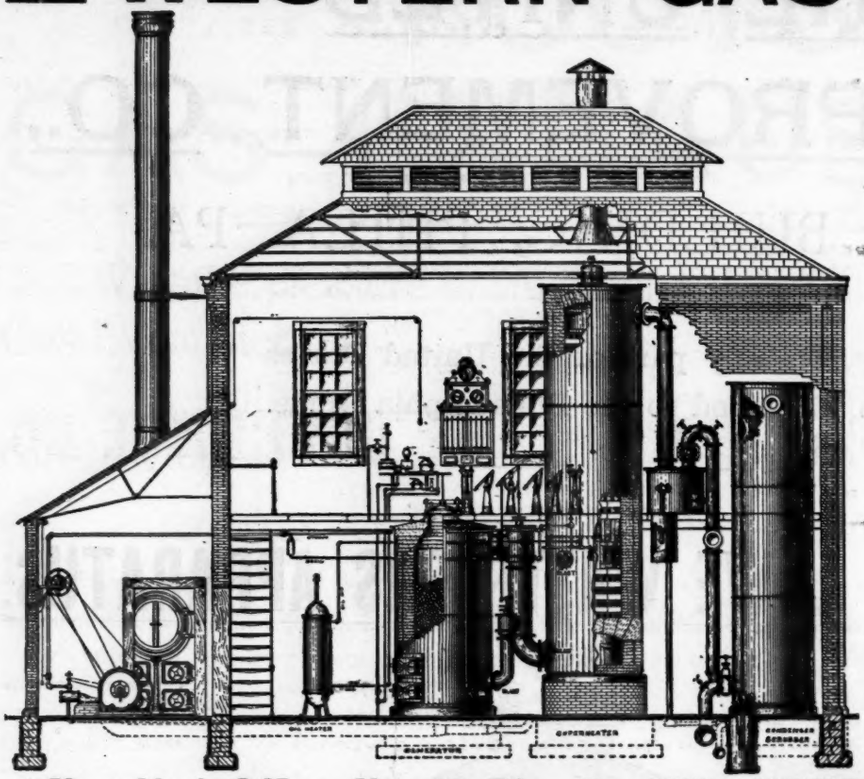

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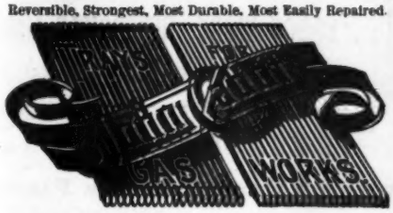

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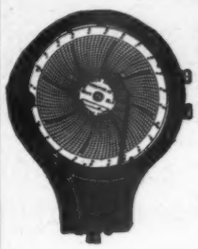

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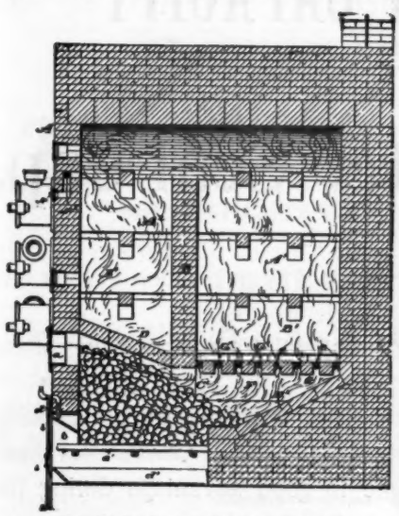

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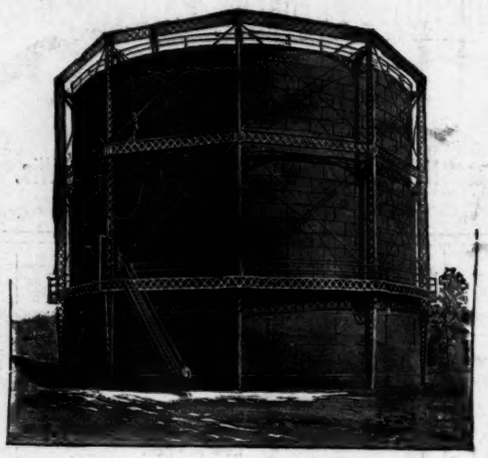

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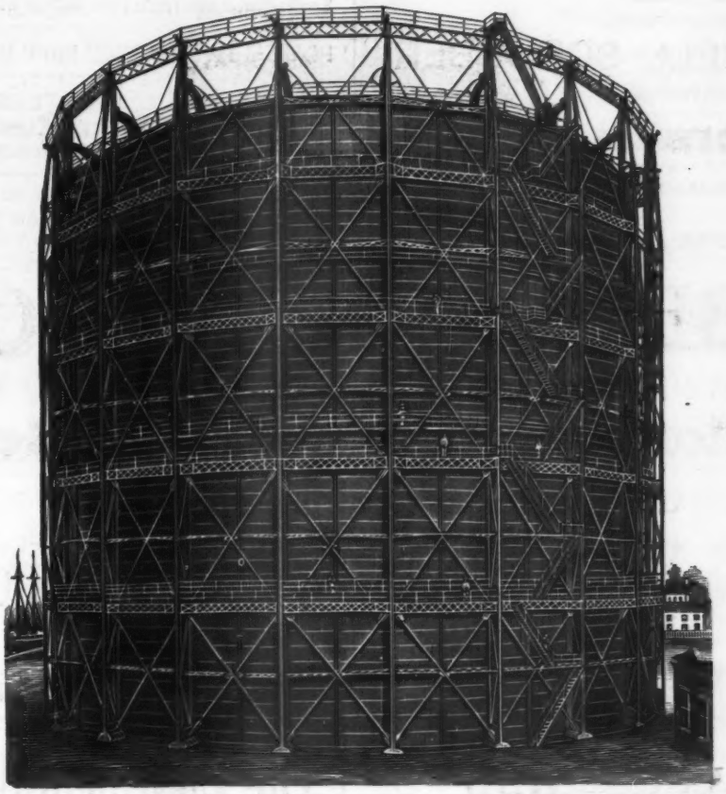

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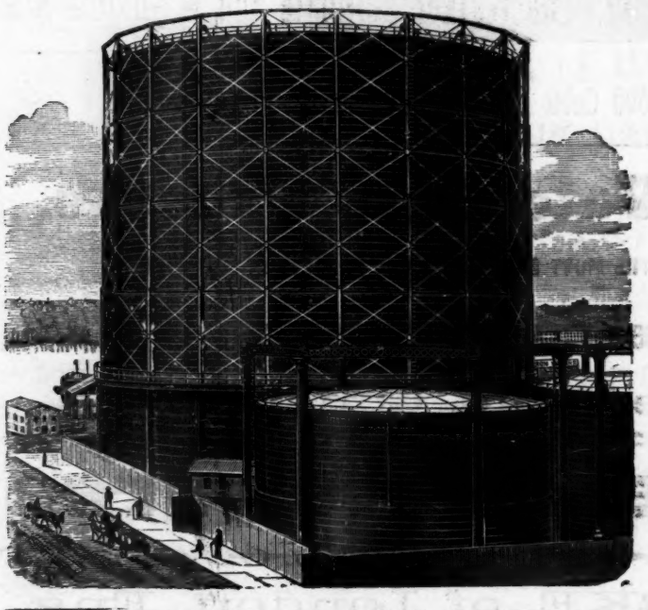

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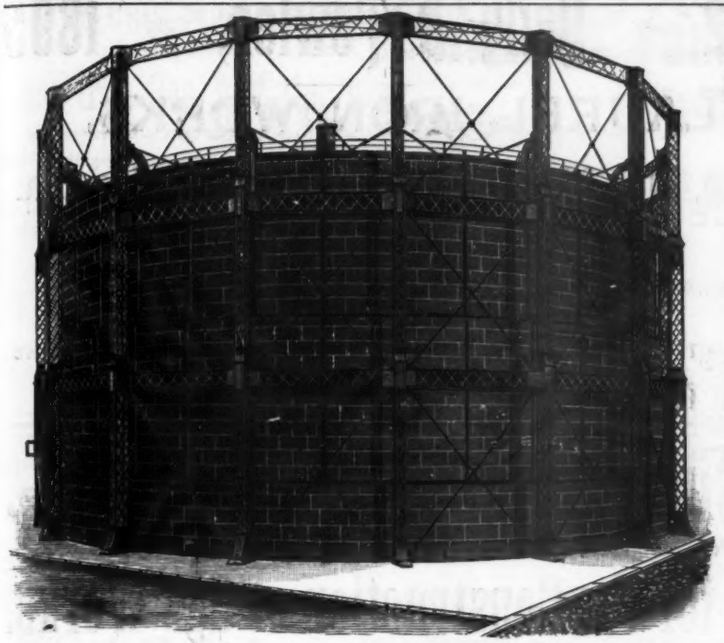

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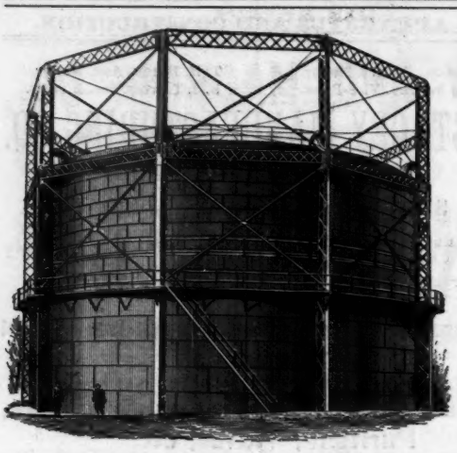

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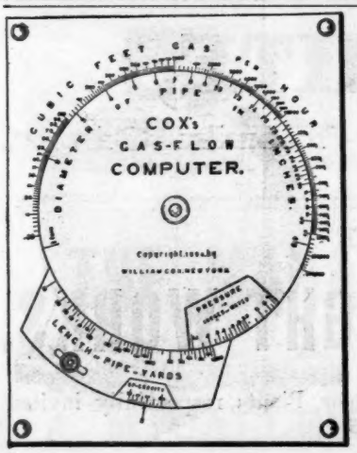

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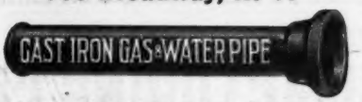

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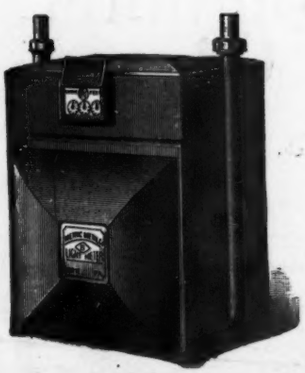

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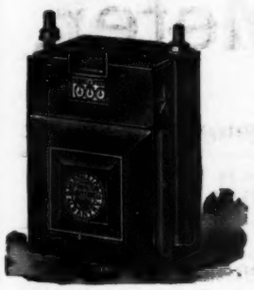

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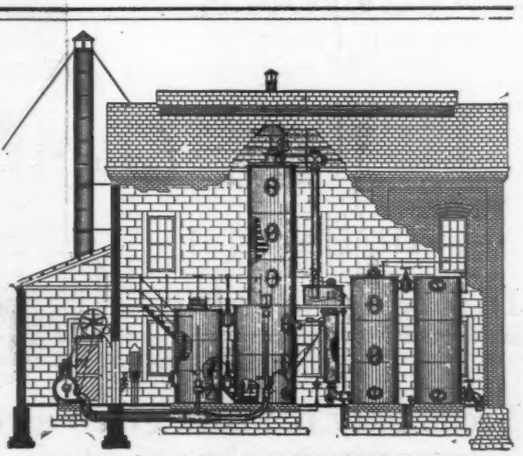

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